

Waterways Postgraduate Student Conference 2020



3

Wednesday, November 11 2020
University of Canterbury,
Christchurch, New Zealand



**LINCOLN
UNIVERSITY**
TE WHARE WĀNAKA O AORAKI

UC
UNIVERSITY OF
CANTERBURY
Te Whare Wānanga o Hāroko
CHRISTCHURCH NEW ZEALAND

Waterways
Centre for Freshwater Management

The Organising Committee would like to acknowledge our generous sponsors:

Platinum



Gold



Silver



Bronze



The Waterways Centre for Freshwater Management is a teaching and research centre, jointly supported by the University of Canterbury and Lincoln University. Established in 2009, it aims to improve the knowledge-driven management of freshwater resources by offering a full complement of nationally accredited tertiary courses and actively supporting postgraduate research programmes.

Conference Programme

Time	Presentation	
8:30	Registration	
9:00	Mihi Whakatau	
9:05	Welcome – Professor James Brasington, Director Waterways Centre for Freshwater Management	
9:15	Mapping the spatial distribution of fine sediment in large braided rivers – method development in the Rangitata	Justin Rogers University of Canterbury
9:30	The influence of atmospheric rivers (ARs) on snow hydrology of the Southern Alps	Rasool Porhemmat University of Canterbury
9:45	Reigniting healthy resilience: using disturbance to overcome negative resistance and resilience in stream restoration	Issie Barrett University of Canterbury
10:00	Effect of copper contamination on nitrogen cycling in freshwater sediment	Tomson Tomoiye Lincoln University
10:15	Are wastewater treatment plants a significant source of microplastics to the environment?	Helena Ruffell University of Canterbury
10:30	Morning Tea	
11:00	Treatment performance variability in two at-source stormwater treatment systems	Forrest Bilek University of Canterbury
11:15	Get them outta here! How dissolved Cu and Zn are filtered out of stormwater by waste seashells	Rachel Skews University of Canterbury
11:30	Characterising surface water – groundwater exchange in the Selwyn/Waikirikiriri River, using radon	Linda Robb University of Canterbury
11:45	Quantifying the elusive: using a radon mass balance approach to estimate groundwater discharge into a large coastal lagoon	Katie Coluccio University of Canterbury
12:00	Assessment of the effects of upstream land uses and riparian vegetation compositions on surface water quality of lowland streams	A Thi Ko Lincoln University
12:15	New Zealand native vegetation for the land application of treated municipal wastewater	Alexandra Meister University of Canterbury

12.30	Lunch; Poster Session	
1:30	More harm than good? The impacts of ultraviolet (UV) filters on the ecology of Canterbury's recreational waterbodies	Hilde Martens University of Canterbury
1:45	How many snails are too many? Sustained high densities of tolerant taxa in post-restoration waterways may hinder recovery through priority effects	Kate Hornblow University of Canterbury
2:00	Investigating the relationship between catchment land-use and water quality in a New Zealand high-country farming environment	Shyam Provost Lincoln University
2:15	Coastal city flood mitigation: the untapped potential of industrial lands	Suphicha Muangsri Lincoln University
2:30	Distribution and habitat preferences of kākahi (<i>Echyridella menziesii</i> -freshwater mussels) in the South Island	Channell Thoms University of Canterbury
2:45	Do no-take whitebait fishing areas benefit īnanga (<i>Galaxias maculatus</i>)?	Andrew Watson University of Canterbury
3:00	Afternoon Tea	
3:30	Characterising riparian saltwater intrusion: the Christchurch shallow aquifer case study	Irene Setiawan Lincoln University
3:45	Influence of closed fishing areas on kōkopu populations	Ben Crichton University of Canterbury
4:00	Low-cost filters for emergency treatment of drinking water for removal of excess fluoride in volcanic areas	Mel Lecompte University of Canterbury
4:15	Anaerobic pond treatment of pig farm effluent in New Zealand: exploring opportunities for enhanced performance	Anna Nilsson University of Canterbury
4:30	Blinded by the light: the influence of LED light on adult aquatic insects in Canterbury rivers	Jessica Schofield University of Canterbury
4:45	A short story of groundwater and sub-surface infrastructure in Ōtautahi/Christchurch	Amandine Bosserelle University of Canterbury
5:00	Drinks and Nibbles; Prize Presentation	

Posters

Poster Title	Presenter
Feasibility of waste mussel shells as engineered living roof substrate component	Stephanie Pratchett and Dylan Edwards University of Canterbury
An assessment of the food-energy-environment-water nexus in the Rangitata river basin under climate change	Derrick Mangoro Lincoln University
Investigating the ecology of īnanga (<i>Galaxias maculatus</i>) in Te Waihora	Christopher Meijer University of Canterbury
Using simplified river catchment maps to direct future restoration efforts	Christopher Meijer University of Canterbury
Assessment of the potential of LUCI to estimate heavy metal loads in urban catchments	Thuy Nguyen University of Canterbury
Source and fate of microplastics in an urban river catchment	Julia Rambacher University of Canterbury
Waste resources as an engineered substrate in extensive green roof systems	Bhuri Rodprasert University of Canterbury
Water conservation benefits in the promotion of conservation agriculture in Nusa Tenggara Barat (NTB) and Nusa Tenggara Timur (NTT) Provinces, Indonesia	Yeni Lincoln University

The 2020 Conference Committee

This year's organizing Committee is:

Issie Barrett	Senior Tutor/PhD candidate, Waterways
Katie Coluccio	PhD candidate, Waterways
Suellen Knopick	Administrator, Waterways
A Thi Ko	MWRM candidate, Waterways
Linda Robb	MWRM candidate, Waterways
Rachel Skews	MWRM candidate, Waterways

The MC for the day is Issie Barrett.

How to find presenters

Presenters and committee members can be identified by coloured name tags. Presenters are keen to hear your questions and feedback, so please feel free to approach them throughout the day. Also, please let a committee member know if you need any assistance.

Posters

There is a scheduled poster session in the foyer from **12:30 to 1:30 pm** when all poster presenters will be available at their poster for questions and discussion. However, please feel free to approach poster presenters throughout the rest of the day.

The WaterNZ People's Choice Award

Please let us know who you think deserves to win for their outstanding oral presentation. At the end of the day, simply fill in the slip of paper at the back of the book and drop it in the box at the front desk. The winner will be announced during the prize presentation.

Welcome

Professor James Brasington Director, Waterways Centre for Freshwater Management



Tēna koutou katoa,

A very warm welcome and thanks for supporting our 10th Waterways Postgraduate Student Conference day!

This day is the first we pen into our calendar at Waterways. It provides a vital opportunity to showcase the research undertaken by our postgraduate students and a chance for them to engage directly with stakeholders from far and wide. The event holds particular significance this year of all years. Opportunities to bring together the broader freshwater community, from iwi to industry and regulation

to research have been few and far between so it is fantastic to see you here today.

The challenges wrought by the pandemic have affected us all in different ways and our students are no exception. Research is often described as a lonely enterprise on the best of days. To see so many of them presenting today is testimony to their commitment and dedication, and the support they have received, both within and beyond our Universities.

On a personal note, this is my first conference as the new Director of the Waterways Centre. It is a privilege to hold this position and take the reins from Jenny after her first rate leadership of the Centre over the last 10 years. I look forward to meeting you, both new faces and more familiar ones. As we begin to craft a new vision for the Centre for the next 10 years, I am keen to hear your perspectives on the emerging challenges in freshwater management and your thoughts on how the Centre might evolve to meet these together with you. I hope this will be the start of a continuing and fruitful dialogue.

Finally, I would like to acknowledge that the day is organised entirely by a committee of Masters and Doctoral research students, supported by our fantastic Administrator, Suellen. We greatly appreciate their efforts. We would also like to thank all of those who support the work of the Centre, through scholarships, support for research expenses or help in-kind, and not least for sponsorship for the conference itself. The research we see here today embodies the tangible results of your generous support.

Ngā mihi nui,

Professor James Brasington

Oral Presentation Abstracts

Mapping the spatial distribution of fine sediment in large braided rivers – method development in the Rangitata



Justin Rogers, PhD candidate

Justin.rogers@pg.canterbury.ac.nz

Supervisors: James Brasington,
Jono Tonkin, UC
Jo Hoyle, NIWA

The accumulation of excess fine sediment in gravel-bed rivers may create a cascade of impacts that degrade ecosystem health, recreational value and natural character. Monitoring the quantity and distribution of deposited fine sediment is based typically on a combination of visual assessment and sparse direct sampling. These methods do not scale well to quantify patterns at the catchment scale or for large, braided rivers where the active fairway extends over hundreds of metres. An alternative method to map, reproducibly, the spatially-explicit and longitudinal distribution of fine sediment cover in large rivers is needed urgently to better understand river management actions and help design restoration strategies.

We present a new approach to this problem based on multi-modal remotely sensed data and apply this to map the pattern of sediment cover for the piedmont reach of the Rangitata River, Canterbury, NZ. Our approach involves multisensory fusion of dense airborne LiDAR and RGB orthophotography acquired from a manned helicopter platform. Combining centimeter-scale LiDAR and optical imagery resolution provides opportunities to retrieve the surface roughness of representative surface facies using the local elevation distribution (Brasington et al., 2012) and the structure of optical reflectance at the scale of the microtopography (Buscombe 2013; Carboneau et al. 2005; Hoyle et al. 2019).

Here, image analysis is combined with ground-truth data to develop and train a machine-learning classification method capable of characterizing longitudinal fine sediment cover over the active bed. The data and classification method will support substrate and geomorphic change mapping after future surveys that include ADCP coverage of channels as well as 2-D sediment transport modelling efforts and ecological effects characterization. Scaling up these methods will increase our understanding of large-scale river health and character over time.

Research / Career Interests:

- Geomorphology and modelling of rivers and coastal waters

The influence of atmospheric rivers (ARs) on snow hydrology of the Southern Alps



Rasool Porhemmat, PhD candidate

Rasool.porhemmat@pg.canterbury.ac.nz

Supervisors: Heather Purdie,
Peyman Zawar-Reza, UC
Christian Zammit, NIWA
Tim Kerr, NZ Rainfall

Seasonal snow is an important element of water resources in the mid-latitudes Southern Alps which influence the timing and magnitude of the alpine river flows. In mid latitudes a sizeable fraction of moisture is transported through atmospheric rivers (AR). ARs are narrow channels of enhanced water vapour within the atmosphere that are responsible for most horizontal transport of moisture outside of the tropics; however, their role in hydrological processes of snow dominated regions such as the Southern Alps of New Zealand is still largely unknown.

The primary objective of this study was to explore the role of ARs in producing large snowfall events and major rain-on snow (ROS) events in the Southern Alps. Atmospheric rivers making landfall in the Southern Alps were found to impact the seasonal snowpacks in two ways. While ARs accounted for the majority of large snowfall events across the Southern Alps (~70%), they were also responsible for nine out of ten largest rain on snow events identified near the Main Divide of the Southern Alps. Hydrometeorological analysis revealed similar characteristics of snow- and rain-generating ARs with an enhanced presence of low and mid-level moisture and pronounced increases of low tropospheric wind velocities.

However, AR related ROS events were characterised by rising freezing level in the atmosphere resulting in a warm environment over the snowpacks, with air temperatures as high as ~10 °C. This conditions led to anomalously rapid snowmelt rates at higher altitudes.

Research / Career Interests:

- Hydrology
- Hydrometeorology
- Snow hydrology

Reigniting healthy resilience: using disturbance to overcome negative resistance and resilience in stream restoration



Issie Barrett, PhD candidate

Issie.barrett@pg.canterbury.ac.nz

Supervisors: Angus McIntosh,
Helen Warburton, UC

‘Resistance’ and ‘resilience’ describe the capacity of ecosystems to withstand and recover from disturbance. Often linked to ecological health, these regularly underpin restoration goals. However, degraded ecosystems can also be resistant and resilient to disturbance (negative resistance and resilience) making their communities highly stable and thus resistant to restoration. We investigated this post-restoration scenario (physical recovery without biological recovery) using a stream mesocosm experiment, demonstrating that presence of a persistent degraded community can hinder biological recovery. We propose that degraded communities must first be destabilised to facilitate biotic recovery. This requires understanding of how degraded communities are assembled, underpinned by trait-environment relationships.

To investigate this, we conducted a meta-analysis of New Zealand streams across both anthropogenic and natural disturbance gradients. Trait-based ordination of communities indicated different disturbance gradients work to shape communities along different axes of community change. This knowledge can inform restoration by identifying disturbances that could be applied to disrupt existing trait-environment relationships, displacing less desired taxa.

We tested this theory in a further channel experiment to investigate how different community types responded to additional disturbance. Response to disturbance depended on disturbance history: if more of the same disturbance was applied, community composition remained relatively stable; if novel disturbances were applied, community composition changed. Thus, there is potential to alter communities and overcome negative resistance and resilience by applying disturbance as a restoration tool to direct community recovery.

Research / Career Interests:

- Restoration, community ecology, macroinvertebrates, outreach, science communication

Effect of copper contamination on nitrogen cycling in freshwater sediment



Tomson Tomoiye, MWRM candidate

Tomson.tomoiye@lincolnuni.ac.nz

Supervisors: Niklas Lehto
Peter Almond, LU

The general aim of my research is to study the effects of copper (Cu) on two key processes in nitrogen (N) cycling: nitrification and denitrification in otherwise uncontaminated river sediment. High concentration of trace elements has a negative influence on biological process, including a variety of microbial functions.

The aim of this research was tested through a controlled laboratory-based study using experimental sediment mesocosm with different concentration of Cu. Depth profile measurements of trace elements, Cu, Fe and Mn will reveal the mobilisation of these trace elements below the sediment-water interface; the latter two will also provide information about the redox gradients in the sediment. Further depth profile measurements of NO₃⁻ and NH₄⁺ will provide new information of how the cycling of these two key N species is affected by the Cu treatment, while measurement of N₂O gas will provide information about the treatment effect on denitrification.

Measurement of the mobilisation of key chemical species at different depths in the sediment were carried out using the diffusive gradients in thin-films (DGT) and diffusive equilibria in thin-films (DET) methods.

The data collected will provide the first measurements of Cu effects on N cycling in an NZ freshwater sediment. It will also be used as a model to derive potential predictions about future circumstances surrounding freshwater sediment in NZ.

Research / Career Interest

- Research / teaching / consulting
- Freshwater management
- Climate change

Are wastewater treatment plants a significant source of microplastics to the environment?



Helena Ruffell, PhD candidate

(Presenting the results of her MSc)

Helena.ruffell@pg.canterbury.ac.nz

Supervisors: Sally Gaw, UC
 Olga Pantos, ESR
 Grant Northcott, Northcott
 Research Consultants Ltd.

Microplastics are ubiquitous in the environment, due to the intensification in global commercial demand for plastics since the 1960s. The detection of microplastics in remote locations and in a range of aquatic organisms has raised questions about the sources of entry into the environment. Wastewater treatment plants (WWTPs) are thought to be a major source of microplastics, particularly microfibres sourced from washing machine effluent, into aquatic and terrestrial environments. WWTPs are not designed to remove microplastics from sewage, and microplastics are retained in sewage sludge or released with effluent. There is currently a lack of data in New Zealand on the amounts and types of microplastics entering and being discharged from WWTPs, and the risk they pose to the environment. This study is the first of its kind to characterise the contribution of microplastics to coastal ecosystems from different WWTPs in Canterbury, New Zealand.

A field study of four tertiary WWTPs was undertaken in the Canterbury region across the month of June 2018. Representative influent and effluent samples were collected from each WWTP, comparing weekdays to weekends. An additional field study focusing on microplastic differences in the effluent from three WWTPs was undertaken bi-monthly from June – December 2018 to assess temporal trends.

The findings of this study suggest the need for greater regulation of plastic consumer products to mitigate the risk of microplastics to the environment.

Research / Career Interest

- Waste minimisation, environmental contamination

Treatment performance variability in two at-source stormwater treatment systems



Forrest Bilek, PhD candidate

Forrest.bilek@pg.canterbury.ac.nz

Supervisors: Tom Cochrane,
Frances Charters,
Aisling O'Sullivan, UC
Michael Hannah

Stormwater treatment systems (STSs) are being integrated across our urban landscapes in New Zealand and around the world with the intent of contaminant removal. Downstream water quality and ecological health improvements are expected to follow STS installation; however, this is often not the case due to variability in treatment performance. This study seeks to identify and quantify the impact of the most influential variables affecting the performance at-source STSs.

Two media filtration STSs, which target the removal of dissolved Zn from galvanized roof runoff, were tested at the University of Canterbury in Christchurch. Both STSs were located on different sections of the same roof, with variations of media: one incorporated fresh mussel shells, dried and crushed, while the second incorporated pre-crushed, weathered mussel shells. Runoff was analysed for total and dissolved metals.

Treatment variability of dissolved zinc was higher within the 'fresh-shell' STS than the 'weathered shells' STS, with removal efficiency ranging respectively from 20% to 45% (average 34%), and 71% to 87% (average 82%). Treatment performance of the 'fresh-shell' STS may be influenced by the smooth media surface that is comparatively un-weathered, providing fewer binding sites. Variability in treatment from both STSs stems from variation in dissolved zinc concentrations in runoff.

Research / Career Interest

- Stormwater quality characterisation
- Ecological treatment systems for water quality

Get them outta here! How dissolved Cu and Zn are filtered out of stormwater by waste seashells



Rachel Skews, MWRM candidate

Rachel.skews@pg.canterbury.ac.nz

Supervisors: Jenny Webster-Brown,
Frances Charters,
Tom Cochrane,
Aisling O'Sullivan, UC

Dissolved zinc (Zndiss) and copper (Cu-diss) are a threat to aquatic life, but continue to enter urban waterways largely via stormwater passing over roofing and cladding materials ubiquitous in the urban environment. Most stormwater treatment is aimed at removing particulates, so a retrofittable downpipe-scale device was developed to remove dissolved metals from runoff prior to it reaching the stormwater network. The waste seashell media inside has been shown to be effective at removing Zndiss and Cudiss (>90% and >75% respectively), but the mechanisms of removal are unconfirmed.

This study used a multi-technique approach to investigate potential mechanisms of Zndiss and Cudiss retention. Laboratory column results showed reductions of 73-97% for Zndiss and 55-82% for Cudiss, for concentrations ranging over 2 and 3 orders of magnitude respectively. PHREEQC modelling suggests that Cudiss could be reduced by up to 99% by precipitation of copper hydroxide carbonate minerals, while no stable Zn minerals are predicted to form at the measured pH. Further PHREEQC modelling suggests there was insufficient hydrous ferric oxide (HFO) for adsorption onto this mineral to be a dominant removal mechanism. A sequential extraction of used seashell media released the largest proportions of Zn from the "carbonate" fraction, while Cu was released from both the "carbonate" and "HFO" fractions. SEM-EDS analyses of used media rarely highlighted 'hotspots' of Zn or Cu, instead showing low levels uniformly spread through the shell structures.

Research / Career Interest

- Water management
- Water treatment
- Water quality
- Behaviour change

Characterising surface water – groundwater exchange in the Selwyn/Waikirikiriri River, using radon



Linda Robb, MWRM candidate

Linda.robbs@pg.canterbury.ac.nz

Supervisors: Leanne Morgan, UC
Eddie Banks, Flinders University
Scott Wilson, Lincoln Agritech

Many rivers in New Zealand recharge the underlying aquifer system, assisting with groundwater storage and sustaining spring flows. However, in braided rivers, estimates of river-aquifer fluxes have considerable uncertainties (Close et al., 2014). A promising approach for characterising surface water – groundwater exchange involves environmental tracers such as radon, a radioactive tracer with a half-life of 3.82 days (Bourke et al., 2014; Lamontagne & Cook, 2007; Sadat-Noori & Glamore, 2019).

However, before we estimate these losses, it is important to understand the background variability of radon in the subsurface. This is the focus of this research, which involves determining the spatial variability in radon emanation rates in an alluvial deposit adjacent to a braided river; the Selwyn/ Waikirikiriri.

This study involves determining the grain size distribution and aquifer properties from sediments. Radon emanation rates will be calculated to see how these vary spatially and with different sediment sizes. Measuring radon in groundwater and comparing to the emanation rates of the sediments at the same sites will show how useful radon is as a tracer for characterising groundwater-surface water interaction.

Research / Career Interests

- Groundwater

Quantifying the elusive: using a radon mass balance approach to estimate groundwater discharge into a large coastal lagoon



Katie Coluccio, PhD candidate

Katie.coluccio@pg.canterbury.ac.nz

Supervisors: Leanne Morgan,
Marwan Katurji, UC
Isaac Santos, Southern Cross
University
Fouad Alkhaier, ECan

Coastal lagoons are found on coastlines throughout the world and have a diverse set of ecological, cultural, economic, social and recreational values. Groundwater inflow may significantly influence lagoon water quality, yet it is a poorly understood part of lagoon hydrology. This research tests the question of whether groundwater seepage to a large coastal lagoon in Canterbury (Te Waihora/Lake Ellesmere) is only a small proportion of the overall lagoon water budget, as estimated in previous work based on seepage meter measurements.

The current study used a broad-scale radon mass balance approach to estimate groundwater discharge to the lagoon in two seasons, by accounting for all inputs and outputs of the noble gas ^{222}Rn – a naturally occurring groundwater tracer. Given the highly wind-affected nature of this site, atmospheric evasion of ^{222}Rn is a significant component of the radon mass balance. Therefore, groundwater discharge estimations are provided for several evasion scenarios. In-depth uncertainty analysis was carried out on each component of the radon budget. Results from the radon mass balance revealed groundwater discharge to the lagoon to be 1-2 orders of magnitude higher than earlier estimates.

Where it was previously thought that direct groundwater seepage into the lagoon was a small proportion of the water balance, it appears now that it may be an important component of the water budget. These results also reveal that there may be more exchange of water through the barrier between the lagoon and sea than previously thought.

Research / Career Interests

- Research, teaching, consulting
- Applied hydrology and hydrogeology

Assessment of the effects of upstream land uses and riparian vegetation compositions on surface water quality of lowland streams



A Thi Ko, MWRM candidate

Athiko@lincolnuni.ac.nz

Supervisors: Crile Doscher,
Niklas Lehto, LU

Water quality problems are found to be associated with land-based developments in agriculture, urbanization and socio-economic activities in catchment areas. Non-point source discharges have been classified as a major concern over the impact of land uses on river water quality. Previous studies have shown that riparian plantings (vegetation along the riverbank) can filter nutrient and sediment from non-point discharges. However, the effectiveness of riparian buffer strips is determined by its vegetation composition such as shaded and grassland buffer and the width of riparian area. This research focuses on assessing the ability of different riparian vegetation compositions (shaded, un-shaded/grassland and unplanted areas) in reducing nutrient and sediment inputs from different land uses.

The Styx River catchment in Christchurch, which has a wide range of riparian vegetation composition, was chosen as study area. Water quality samples were collected over eight dates (fortnightly over five dates and three dates after rain events) from nine sampling sites in the Styx and its main tributaries: Smacks and Kaputone Creeks. The samples are analysed for nutrients (nitrogen and phosphorus) and total suspended solids to calculate nutrient and sediment loads and catchment land uses for each sampling site will be determined using ArcGIS software. This data will help determine whether or not the different riparian vegetation composition helps reduce nutrients and sediment loads entering waterways from different catchment land uses.

Research / Career Interests

- Integrated water resource management
- Ecosystem services

New Zealand native vegetation for the land application of treated municipal wastewater



Alexandra Meister, PhD candidate

Alexandra.meister@pg.canterbury.ac.nz

Supervisors: Brett Robinson,
Sally Gaw, UC
Maria Jesus Gutierrez-Gines, ESR
Nicholas Dickinson, LU

The irrigation of treated municipal wastewater (TMW) onto land has demonstrable environmental and economic benefits. It reduces the contaminants that enter waterways and therefore has positive effects on the water quality. Irrigation of TMW onto New Zealand native vegetation could potentially support the production of valuable native products and create zones of ecological value.

In 2015, a field trial was set up in Duvauchelle (Banks Peninsula) to study the effects of TMW on the establishment of native vegetation and the fluxes of nutrients in the underlying soil. Specifically, we aimed to determine whether a TMW irrigation rate of 1000 mm per year would result in excess nutrient leaching, accumulation or depletion of elements in soil, and changes in the survival and growth of eleven native plant species. Soil and plant samples were collected for analysis after three years of TMW irrigation.

Results indicated that TMW irrigation did not lead to significant soil degradation, accumulation of toxic elements, or induction of nutrient imbalances. The growth of most plant species was accelerated by TMW irrigation. However, some plant species were not well adapted to the site. TMW irrigation did not increase the plant tissue concentration of elements that may be harmful in food chains.

The field trial supports the possibility of establishing native vegetation for TMW irrigation in New Zealand and highlights the importance of species selection as a critical success factor.

Research / Career Interests

- Land application of wastewater
- Soil chemistry
- Nutrient fluxes
- Native vegetation

More harm than good? The impacts of ultraviolet (UV) filters on the ecology of Canterbury's recreational waterbodies



Hilde Martens, MSc candidate

Hilde.martens@pg.canterbury.ac.nz

Supervisors: Jon Harding,
Sally Gaw, UC

Ultraviolet (UV) filters, commonly known as sunscreen agents, are emerging organic contaminants with the potential to cause adverse ecological effects in freshwater and marine ecosystems. These ultraviolet filter compounds are used to slow photodegradation and therefore probably persist for some time in the environment. Studies overseas have indicated their presence in waterbodies as they are washed off humans during wading, swimming and washing activities. However, there is little information in New Zealand on the concentration of UV filters at swimming sites. Additionally, overseas data indicates that some of these compounds have negative effects on aquatic organisms. Thus, there is a need to fill these knowledge gaps and address potential environmental issues.

The aim of this study is to investigate the presence of UV filters in selected waterbodies across Canterbury. We sampled over summer (February-March) and winter (July-August) at popular swimming sites, both marine and freshwater, to quantify concentrations and seasonal patterns in both sediment and water. Gas chromatography–mass spectrometry was used to analyze for seven compounds commonly included in sunscreens (e.g. homosalate, avobenzene, and octocrylene). While there is substantial information overseas on the potential ecological effects these compounds are having, no such data has been recorded for New Zealand. As New Zealand's freshwater systems are dominated by endemic taxa, we will also be investigating the toxicity of some filters on selected local freshwater taxa.

Research / Career Interests

- Freshwater ecology
- Emerging contaminants
- Environmental chemistry

How many snails are too many? Sustained high densities of tolerant taxa in post-restoration waterways may hinder recovery through priority effects



Kate Hornblow, MSc candidate

Kate.hornblow@pg.canterbury.ac.nz

Supervisors: Helen Warburton,
Angus McIntosh, UC

More successful stream restoration is needed following continued waterway degradation. Common restoration methods (e.g. riparian planting) can improve physical conditions, but are often unsuccessful in regaining sensitive macroinvertebrates. Failure to account for biotic interactions between established tolerant taxa and desired re-colonizing taxa (e.g., Ephemeroptera, Plecoptera, and Trichoptera; EPT) could explain why physical restoration methods don't always result in ecological recovery.

Potamopyrgus antipodarum, a native mudsnail, dominates agricultural waterways in Canterbury (typically, 1,000 – 70,000 per m²), and persists at high densities in post-restoration waterways. To investigate if sustained presence of a tolerant species could hinder restoration through priority effects, we manipulated densities of *P. antipodarum* in artificial stream mesocosms and measured EPT colonization over time. Higher snail densities resulted in significantly higher EPT drift rates and lower cumulative EPT colonization. Final EPT colonization had a negative linear relationship with *P. antipodarum* density, with reduced EPT colonization from 1000 *P. antipodarum* per m² upwards. Biomass of EPT started replacing *P. antipodarum* biomass in our three lowest density treatments, indicating a density threshold around 5,700 *P. antipodarum* per m², below which EPT colonization was more successful. These values could be used as ecological baselines or targets for future restoration projects if methods to reduce densities of tolerant taxa like *P. antipodarum* snails can be devised. Overall, our results highlight that ignoring biotic interactions like priority effects could lead to restoration failure.

Research / Career Interests

- Freshwater macroinvertebrates, restoration ecology and community ecology

Investigating the relationship between catchment land-use and water quality in a New Zealand high-country farming environment



Shyam Provost, PhD candidate

Shyam.Provost@Lincolnuni.ac.nz

Supervisors: Nicholas Dickenson,
Niklas Lehto,
Tom Maxwell, LU

The intensification of land-use within a freshwater catchment can increase nutrient enrichment and sediment loads, in-turn leading to a decline in water quality. However, previous work has suggested that such relationships may only be observed during intense weather events. The aim of this research has been to investigate the effect of high-country catchment land-use on the mobilisation of phosphorus (P), nitrogen (N), dissolved organic carbon (DOC), and suspended sediment (SS) to waterways during high-flow rainfall events.

Monitoring stations were set up at the lower reaches of two neighbouring stream catchments at Mt. Grand Station (Lincoln University's high-country Merino sheep farm near Lake Hawea). Continuous monitoring of stream stage height, turbidity, electrical conductivity and rainfall is being undertaken and automatic samplers have collected water samples at pre-determined stream stage heights that are indicative of a high-flow rainfall event. The vegetation cover in each catchment will be determined using Arc-GIS and satellite imagery, quantifying the percentages of native tussock grasses, exotic pasture grasses, kānuka shrubland, and other woody shrub growth.

It is hypothesised that an increase in exotic pasture grass (where more intensive land-use can be facilitated) will be positively correlated with increases of P, N, DOC and SS being mobilised the waterway from the surrounding catchment.

Research / Career Interests

- High-country
- Water quality
- Nutrient enrichment
- Sediment erosion
- Soil carbon

Coastal city flood mitigation: the untapped potential of industrial lands



Suphicha Muangsri, PhD candidate

Suphicha.muangsri@lincolnuni.ac.nz

Supervisors: Wendy McWilliam,
Steve Ulrich, LU
Tim Davies, UC

Protecting vulnerable coastal cities from flooding under the pressure of climate change is challenging. Engineering structures are internationally recognised as inadequate for reducing flood risk. Green infrastructure (GI) has the potential to provide supplementary flood mitigation; however, to be effective it has to be designed in the right place, and this may not be where there is municipally-owned land. Privately owned industrial land may play a more effective role; however, little is known about its capability for flood mitigation.

The land unit analysis and the rational method are used in this study to determine its potential role in Christchurch. The results demonstrate that the size of industrial land and the upstream drainage area are key to increasing flood mitigation capability. If green infrastructure is placed on all industrial lands capable of playing a flood mitigation role, their downstream communities will be protected from flooding up to 60 cm sea level rise (projected to occur within about 50 years), even following extreme weather events. However, with a sea level rise of over 60 cm, additional flood mitigation will be needed to protect the city's more vulnerable communities.

Research / Career Interests

- Coastal city flooding
- Climate change
- Industrial green infrastructure

Distribution and habitat preferences of kākahi (*Echyridella menziesii*-freshwater mussels) in the South Island



Channell Thoms, PhD candidate

Channel.thoms@pg.canterbury.ac.nz

Supervisors: Jon Harding,
John Pirker, UC
Catherine Febria, University of
Windsor

Habitat preferences of kākahi (*Echyridella menziesii* – endemic freshwater mussels) are not fully understood. We investigated distribution and habitats of kākahi in lotic environs within the Ngāi Tahu /Kāi Tahu takiwā of the South Island.

From fieldwork surveys, we found distributions were patchy, and that kākahi can occur in a range of benthos types including silt, sand, gravel, cobbles and among macrophytes.

Although it appears kākahi can persist in a range of environments, we were interested to see if given a choice they might show preference for certain substrata. We conducted habitat choice experiments and preliminary findings indicate that kākahi do not appear to show preference for substrate type.

Research / Career Interests

- Restoration ecology
- Mahinga/mahika kai species

Do no-take whitebait fishing areas benefit īnanga (*Galaxias maculatus*)?



Andrew Watson, PhD candidate

Andrew.watson@pg.canterbury.ac.nz

Supervisors: David Schiel,
Mike Hickford, UC

No-take freshwater reserves are an under-used tool in precautionary fisheries management. Here, we compare different types of no-take freshwater reserves established to prevent over-exploitation of New Zealand's iconic whitebait fishery (mostly *Galaxias maculatus*, or īnanga). Decades ago, several areas on the West Coast were closed to whitebaiting. However, the application of closure was applied at different hierarchical spatial scales. For example, there was full closure at the watershed scale (with little to no fishing downstream) or partial closure at the stream-segment scale (with fishing downstream).

We studied 10 streams classified into three a priori types: (i) closed, (ii) partially closed, and (iii) open. We quantified the effects of these reserve types and evaluated their performance as reproductive reservoirs for fisheries enhancement.

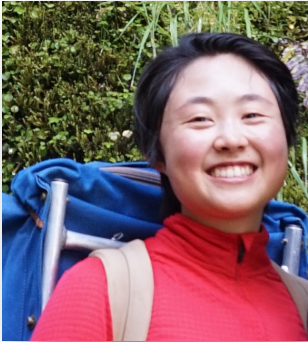
We found that closed streams had greater abundances, biomasses, and egg production of īnanga despite having a greater proportion of smaller fish compared to partially closed and open streams. Community-level analyses indicated differences in fish assemblages between closure types. Large, predatory fish were more common in closed streams. Overall, there were notable reserve effects related to closed streams, but partially closed streams fell short of meeting fisheries enhancement expectations.

We conclude that to maximize reserve effects, closure must occur from the mouth of a watershed with no fishing downstream, and establishment of future reserves must focus fishery protection on 'target-species' in high quality habitat.

Research / Career Interests

- Conservation biology
- Aquatic ecology,
- Community ecology
- Stream and watershed assessment

Characterising riparian saltwater intrusion: the Christchurch shallow aquifer case study



Irene Setiawan, PhD candidate

Irene.setiawan@lincolnuni.ac.nz

Supervisors: Leanne Morgan, UC
Crile Doscher, LU

Riparian saltwater intrusion is the displacement of fresh groundwater by saline water from tidal rivers or streams. Generally, saltwater intrusion is thought of as occurring at the coast, with seawater being the source of salinity. Saltwater intrusion from tidal surface water bodies into shallow aquifers has received little attention in the published literature, despite tidal surface water bodies being an increasingly important salinity source under sea level rise. Tidal surface water bodies, including coastal rivers, act as conduits that facilitate the movement of saltwater upstream at great distances from the coast, which can contaminate fresh groundwater in adjacent shallow aquifers.

This study draws on the Christchurch shallow aquifer adjoining the Avon River as a case study site. This presentation seeks to discuss the results-to-date on some facets of the study, which explore riparian saltwater intrusion mechanisms through a field investigation and map shallow groundwater salinity across Christchurch.

The field investigation involves monitoring shallow groundwater and river level, temperature, and specific conductance at a high temporal resolution at several locations to understand the dynamics of riparian saltwater intrusion. While the shallow groundwater salinity mapping involves a snapshot data collection campaign across coastal Christchurch and Kaiapoi, where existing shallow wells are purged and measured for specific conductance and other parameters to understand the current status of shallow groundwater salinity in Christchurch.

Research / Career Interests

- Saltwater intrusion
- Sustainable groundwater management
- Climate change resilience

Influence of closed fishing areas on kōkopu populations



Ben Crichton, MSc candidate

Bcr53@uclive.ac.nz

Supervisors: Mike Hickford,
Angus McIntosh,
David Schiel, UC

Investigating the effects of New Zealand's whitebait fishery on harvested species is vital to ensure a sustainable fishery that does not threaten the conservation of component species. We tested whether whitebaiting influenced the population characteristics of three native species: the non-threatened banded kōkopu (*Galaxias fasciatus*), declining giant kōkopu (*Galaxias argenteus*), and nationally vulnerable shortjaw kōkopu (*Galaxias postvectis*).

The West Coast of the South Island has many 'refuge' areas that have been closed to whitebaiting for several decades. Using spotlighting to sample fish communities, we measured the abundances, sizes, weights, movements, and growth rates of the three nocturnal kōkopu species across three closed and five fished areas bimonthly. To isolate the effects of whitebaiting on fished waterways, the influence of additional variables such as intra- and inter-specific interactions, forest canopy cover, and in-stream habitat were also measured. Initial findings indicate that there are differences in kōkopu population size class structure between fished and closed areas, with closed stream populations having a smaller median fish length. We are currently examining which population characteristics cause this difference between treatments. These findings will be useful in determining the influence of whitebaiting on population dynamics and ultimately how to best manage the whitebait fishery.

Research / Career Interests

- Aquatic ecology
- Conservation biology
- Fishery sustainability

Low-cost filters for emergency treatment of drinking water for removal of excess fluoride in volcanic areas



Mel Lecompte, MWRM candidate

Mel.lecomppte@pg.canterbury.ac.nz

Supervisors: Sally Gaw,
Brett Robinson, UC

Fluoride toxicity affects millions of people worldwide and is mainly caused by drinking water with elevated fluoride. De-fluoridation of drinking water is the most viable solution, yet most technologies are unsuitable for resource-poor areas. Various forms of calcium-carbonate materials are effective in fluoride removal, especially in acidic conditions, but many are problematic for cultural or practical reasons. Coral sand is mainly calcium-carbonate, has yet to be thoroughly investigated and is conveniently widespread in the Pacific where fluoride toxicity exists.

In fixed-bed column format, using various sand-to-fluid ratios, citric acid concentrations and contact times, I investigated the ability of low-cost coral sand filters to remove fluoride over multiple days. Results indicate that with a 5:1 ratio, 0.025M citric acid and a 4-hour contact period, filters could be used seven times to reduce fluoride from 10 mg/L to below the 1.5 mg/L safe drinking water guideline. Increasing the acid to 0.05M improved fluoride removal in the first few uses but may reduce its effectiveness long term. Preliminary results also indicate that the output water from first use(s) may be unsafe to drink. Components (e.g. Al, Fe, Cr) are released from the sand which are aesthetically unpleasing (yellow), interfere with electrode analysis, and are problematic in terms of drinking water safety. Further investigations are underway, but the sand may require a pre-treatment step for safe use as a de-fluoridation technique.

Research / Career Interests

- Water, sanitation and health (WASH)
- Disaster management
- Water quality and quantity
- Sustainability
- Climate change

Anaerobic pond treatment of pig farm effluent in New Zealand: exploring opportunities for enhanced performance



Anna Nilsson, PhD candidate

anna.nilsson@pg.canterbury.ac.nz

Supervisors: Ricardo Bello Mendoza,
Aisling O'Sullivan, UC
Susan Masten, Michigan State
University

Pig slurry generates environmental challenges like odours, eutrophication of waterways, and the release of greenhouse gases, if inadequately handled. Slurry can be treated in anaerobic pond systems to mitigate environmental impacts, but pond systems often do not operate as intended. Depending on the pig diet, the slurry may contain a high fat content. Fat can cause issues in anaerobic digestion such as foaming and uneven methane production.

The objective of this project is to explore ways to enhance the performance of covered anaerobic ponds to increase methane production, reduce odour emission, and improve digestate quality. The methane production and effluent quality of pond systems on two pig farms will be characterised and compared. One farm uses a fat-rich dairy by-product in the pig feed and reports anaerobic pond issues, while the other farm does not use the fat-rich dairy by-product and reports no issues.

The pond digestate will be analysed for several parameters including fats, phosphorous, nitrogen, and volatile solids. Biogas composition will be monitored and a simple odour survey will be conducted. Bench-scale reactors will be used to assess the biochemical methane potential of the slurries, and to analyse the combined effects of organic loading, temperature, and co-digestion with other agricultural waste.

The research will lead to recommendations for improving performance of anaerobic ponds.

Research / Career Interests

- Environmental sustainability
- Anaerobic digestion
- Biogas
- Waste management
- Sustainable agriculture

Blinded by the light: the influence of LED light on adult aquatic insects in Canterbury rivers



Jessica Schofield, MSc candidate

Jessica.schofield@pg.canterbury.ac.nz

Supervisors: Jon Harding, UC
Kristy Hogsden,
Michelle Greenwood, NIWA

In New Zealand, little is known about the effect of artificial lights, such as street and park lighting, on freshwater organisms. Currently councils are converting streetlights from high-pressure sodium lamps to more energy efficient light emitting diodes (LEDs). Artificial lighting at night can have detrimental effects on freshwater adult insects. Light can attract adult insects from their flight path along rivers, which may cause a loss of recruitment back to the river.

Shorter wavelengths of light (UV, blue, green) are more visible to adult insects than longer wavelengths (yellow, orange, red). Therefore, freshwater adult insects are expected to be more affected by cooler white LEDs (6500 K) that have a greater peak in intensity of blue light than warmer colour temperatures (3000 K).

We investigated the influence of LED lighting on adult caddisfly species by comparing four colour temperatures: 3000 Kelvin (K), 4000 K, 5650 K and 6500 K LEDs. 20 LED light traps were set up per night at three Canterbury rivers on warm, calm nights. Findings show evidence of a differential influence of colour temperature on different taxa. In a separate experiment, 10 lights were set up from 0-100 m from the river to observe how distance of LED lights from rivers affects the attraction of adult insects. This study aims to improve knowledge of the ecological effects of LED lights at night and inform urban lighting decisions.

Research / Career Interests

- Urban streams
- Macroinvertebrate adult communities
- Freshwater ecology and management

A short story of groundwater and sub-surface infrastructure in Ōtautahi/Christchurch



Amandine Bosserelle, PhD candidate

amandine.bosserelle@pg.canterbury.ac.nz

Supervisors: Matthew Hughes,
Leanne Morgan,
Tom Logan, UC

Ōtautahi/Christchurch lies on what was in the pre-1850s, a vast landscape of wetlands. With the creation of a city in the flat low-lying coastal zone close to many waterways, the shallow groundwater system started to modify. The two catchments of the Avon/Heathcote Estuary Ihutai had approximately 5,215 hectares of surface water or near-surface groundwater before the drainage network changed the wet areas to the remaining less than 6% of wetland in the city bounds. The development of the separate water-related pipe networks and pump stations discharging the stormwater and wastewater resolved stagnant water and emerging health issues in the 1860s, creating dry-land allowing the expansion of the city to the current 2020 layout.

The 2010-2011 Canterbury Earthquake Sequence significantly modified ground conditions. Subsequent repairs and investigations were accompanied with the creation of an extensive monitoring network and an opportunity to increase our knowledge into the shallow groundwater in Ōtautahi/Christchurch. The high density spatial and temporal measurements of water level changes after the earthquakes allow some interpretation of the groundwater infiltration effects. The lowering of the water table elevation is not uncommon in urban settings globally and was observed in Ōtautahi/Christchurch pre-earthquake. However, earthquake repairs and water-tightening of the city sub-surface network have the potential to induce groundwater rise in an unplanned way.

This proposed research fills a key gap in understanding the shallow groundwater variations around the infrastructure network and enhancing urban resiliency.

Research / Career Interests

- Coastal hydrogeological and saltwater intrusion in fresh groundwater systems

Poster Abstracts

Feasibility of waste mussel shells as engineered living roof substrate component



**Stephanie Patchett and Dylan Edwards,
BE(Hons) Candidates**

scp60@uclive.ac.nz, dhe56@uclive.ac.nz

Supervisors: Simone Larcher,
Aisling O'Sullivan, UC

Living roofs are an increasingly popular strategy to reduce the demand on stormwater drainage networks, and mitigate the harmful effects of urban stormwater contaminants on receiving waterways. In addition to their direct stormwater management benefits, living roofs have the potential to provide a low impact treatment system for stormwater runoff from exposed neighbouring rooftops. The substrate layer of a living roof provides a unique opportunity to reutilise certain waste materials in such a way that supports stormwater management capabilities and may facilitate additional treatment.

This research assesses the feasibility of waste mussel shells, spent coffee grounds, and bark chip (and combinations thereof) as living roof substrate components. Zeolite, vermiculite, and fine pumice are also assessed for their potential enhancement of water storage capacity and cation exchange capacity. The investigation is conducted in three phases: (1) 1L bench-top batch analysis of individual material properties, (2) 1L bench-top batch analysis of combined material properties informed by phase 1 results, (3) flow-through-column analysis with stormwater influent. Key physical and chemical properties, and leachate nutrient levels are assessed in relation to national and international living roof guidelines. Key physical properties include water storage capacity, particle size distribution, dry, bulk, and saturated densities, porosity, and organic matter content. Chemical properties include alkalinity, pH, total dissolved solids, dissolved oxygen, electrical conductivity, and salinity. Results are then compared with top-soil and commercially engineered living roof growing media.

Research / Career Interests

- Water quality, ecological engineering, waste stream reuse, living roofs, stormwater management

An assessment of the food-energy-environment-water nexus in the Rangitata river basin under climate change



Derrick Mangoro, MWRM Candidate

Derrick.mangoro@lincolnuni.ac.nz

Supervisors: Markus Pahlow, UC
Nazmun Ratna, LU
Shailesh Singh, NIWA

The unique values of the Rangitata River led to its legislative protection under the Water Conservation Order of 2006, which sets the flow management regime. At present the water is fully or nearly fully allocated in the minimum-to-flood flow band (<110 m³/s). Meanwhile irrigators face supply reliability challenges particularly in the low flow season, avid kayakers and rafters perceive a decline in respective recreational values, fishermen report increasingly less favourable flows and riparian dwellers notice a change in sediment distribution. Expansion of irrigated areas due to production intensification has continued to increase demand for water over the years. The principal abstractor of water in the Rangitata basin is the Rangitata Diversion Race Management Limited (RDRML). RDRML delivers water to five irrigation schemes, two hydropower stations and stockwater races, altogether resulting in at least 30% reduction in river discharge for over 70% of the time.

This investigation aims to inform the stakeholders' decisions for sustainable management of the Rangitata River by adopting a collaborative and bottom-up approach that accounts for the different water-related sectors in the basin and adjacent sub-catchments. Two research questions are addressed: (1) how will the projected climate change scenarios affect the water balance in Rangitata basin? And (2) what strategies should be adopted by RDR shareholders to minimize potential trade-offs due to anthropogenic demands and climate change? To address these research questions an integrated Water Evaluation and Planning (WEAP) model of the Rangitata River basin will be developed. Potential future scenarios will be formulated based on an Abbreviated Risk and Options Assessment for Decision-making (A-ROAD) framework. Scenario simulations, including climate change, will be performed in the model to help inform risk-based mitigation strategies that enhance (i) resilience of irrigators in mid-Canterbury, (ii) sustainable management of the Rangitata River, and (iii) foster cross-sectoral policy formulation to minimize the trade-offs between systems in the food-energy-environment-water nexus.

Investigating the ecology of īnanga (*Galaxias maculatus*) in Te Waihora



Christopher Meijer, PhD Candidate

christopher.meijer@pg.canterbury.ac.nz

Supervisors: David Schiel,
Mike Hickford, UC
Duncan Gray, ECan

Īnanga (*Galaxias maculatus*) are a widespread galaxiid found throughout the Southern Hemisphere. In New Zealand, this species is generally well known, with the migrating juveniles forming the basis of a substantial recreational, cultural and commercial fishery as part of the whitebait catch. The current state of this fishery is unknown and has been a point of contention, though most of the focus has been on riverine populations that spend their early life stages in the sea.

However, many rivers do not directly feed into the sea, but rather flow into coastal lakes and lagoons that may provide suitable habitats for īnanga development in the absence of a saline environment. The largest of these is Te Waihora (Lake Ellesmere) in Canterbury, which has undergone many changes in recent history and now has a managed opening schedule to control the lake's size.

For my PhD thesis, I will investigate the ecology of īnanga in this large coastal lake, with an initial focus on spawning locations and juvenile movements within the lake and its tributaries.

Research / Career Interests

- Freshwater ecology
- Population dynamics
- Food webs
- Threatened species
- Life histories

Using simplified river catchment maps to direct future restoration efforts



Christopher Meijer, PhD Candidate

(Presenting on another project)

christopher.meijer@pg.canterbury.ac.nz

Restoration projects in freshwaters are becoming increasingly important as these ecosystems are faced with increasing threats and greater future uncertainty. However, many restorative projects have had limited success, with failures due to ineffective or inappropriate tools and little or no response from aquatic biota.

The Canterbury Waterway Rehabilitation Experiment (CAREX) has focused on collecting pre-restoration information and trialing a toolbox of targeted restoration approaches in agricultural streams. As part of our recent work in the Ararira/L II River catchment near Christchurch, New Zealand, we developed simplified maps of water quality, instream habitat, sources of contaminants, and fish communities across the catchment. These maps provide an easy visual example of stressors and issues that are a powerful tool to inform landowners and general practitioners.

A review of these maps indicated that the westernmost sub-catchment has multiple water quality and instream habitat issues, but also high ecological values driven by a relatively diverse fish community. Consequently, we suggest that restorative efforts in these waterways should be prioritised over other areas in this catchment due to the greater potential for realised improvement. Moreover, we posit that this approach of collecting pre-restoration information on the affected freshwaters would likely see improvements made in our capacity to restore these aquatic ecosystems.

Assessment of the potential of LUCI to estimate heavy metal loads in urban catchments



Thuy Nguyen, PhD Candidate

thuy.nguyen@pg.canterbury.ac.nz

Supervisors: Markus Pahlow, UC
Bethanna Jackson,
Rubianca Angelica Honrado
Benavidez, Victoria University

Contaminants entering waterways, particularly heavy metals, are a human and environmental health concern in particular in urban areas due to the large fraction of impermeable surfaces such as roofs, car parks and roads. The current work aims at assisting with planning of sustainable urban stormwater systems to address water quality issues. For this purpose a process-based pollutant load model 'Modelled Estimates of Discharges for Urban Stormwater Assessments' (MEDUSA) has been implemented in the Land Utilisation and Capability Indicator (LUCI).

LUCI is an ecosystem services modelling tool, applicable from sub-field to national scales to inform decision making in relation to land management and strategic planning of landscape development and the provision of ecosystem services. MEDUSA can be utilized to simulate event-scale loads of dissolved metal and total suspended solids (TSS). The MEDUSA integration in LUCI was tested for sub-catchments of the Avon river catchment in Christchurch. More specifically, it was parameterised using sampled contaminant loads from key impermeable surfaces and then applied to the Okeover and Addington Brook sub-catchments. An application of MEDUSA to the entire Avon river catchment will be shown, thereby linking sources of contaminant loads to discharge outlets. This can support city planners to better understand how urban planning decisions affect river water quality. This in turn aids in selecting best management options to reduce contaminant load flux from impermeable surfaces and to meet water quality standards.

Research / Career Interests

- Urban hydrology
- Water quality and quantity
- Low impact development controls

Source and fate of microplastics in an urban river catchment



Julia Rambacher, PhD Candidate

julia.rambacher@pg.canterbury.ac.nz

Supervisors: Sally Gaw, UC
Olga Pantos, ESR
Amanda Valois, NIWA

Microplastics (<5mm) are all around us. While there is a growing body of evidence on the impacts of small plastic particles on the marine environment, the role of freshwater systems in the transport of land-generated plastic debris to the ocean have recently become the focus of research. Using the Kaiwharawhara Stream in Wellington as a model system, my project aims to determine: A) the sources and likely entry points of plastics to riverine systems, and B) their fate within these systems. The levels, size, morphology, and composition of microplastics in the water column and sediment will be determined from samples collected during base flow and storm events.

We expect plastic litter to degrade and become brittle over time, providing a suitable substrate for the development of microbial communities. To test this, we will deploy 3 plastic polymers types in the river and examine their fate using both scanning electron microscopy (SEM) to visualize physical surface alterations, and gene sequencing techniques to identify the microbial communities that form. Lastly, a feeding experiment using kōura (freshwater crayfish) as a model organism, will shed light on the role freshwater macrobiota play in the degradation and size transformation of plastics. As part of nationwide research efforts, results from this study will contribute to a broader understanding of the impacts of plastic pollution in Aotearoa-New Zealand.

Research / Career Interests

- Plastic pollution research and mitigation

Waste resources as an engineered substrate in extensive green roof systems



Bhuri Rodprasert, MWRM Candidate

bhuri.rodprasert@pg.canterbury.ac.nz

Supervisors: Tonny de Vries,
Aisling O'Sullivan, UC

Extensive green roofs are a type of green roof which are ideal for stormwater management with low maintenance requirements. When stormwater flows over impervious layers, such as roads and rooftop, the runoff entrains contaminants such as heavy metals (especially Zinc and Copper) from metal roofs, as well as organic pollutants from bird's dropping and unwanted plant species (moss). Ultimately, this polluted stormwater runoff ends up in the nearby waterways resulting in deteriorating water quality. Green roofs comprise of a shallow substrate with organic and inorganic materials that provide sufficient nutrients and water holding capacity for vegetation. With the proper substrate's composition, extensive green roofs have the potential to treat stormwater. Currently, some of these substrate materials are mined such as pumice but there is an opportunity to capitalize on waste resources to mitigate mining for such raw materials.

Key substrate properties of extensive green roofs include being shallow, lightweight, and benign toward the surrounding environment. Simultaneously, the substrate needs to be able to contain appropriate water holding capacity and adequate nutrients. Previous studies have demonstrated highly effective treatment of dissolved metals, from industry (e.g. coal mining, galvanizing plants) and roof runoff using waste seashells. This research will be investigating the potential of waste seashells to be used as an engineered substrate component in green roofs. It will also assess the ability of green roofs to help treat neighbouring roof runoff, which has not been explored in the green roof industry. Using waste resources as engineered media in green roofs will lower the cost of materials used in constructing green roofs and align to a circular economy.

In this study, an engineered substrate will be created from waste materials (mussel shells, topsoil, and crushed tree barks). The study aims to identify the suitability of the substrate by examining the physical/chemical properties of the new substrates and their ability to support the sustainable growth of the vegetative layers as well as their effectiveness as a point source stormwater treatment.

Research / Career Interests

- Green roofs, stormwater management, water quality

Water conservation benefits in the promotion of conservation agriculture in Nusa Tenggara Barat (NTB) and Nusa Tenggara Timur (NTT) provinces, Indonesia



Yeni, MWRM Candidate

Yeni.yeni@lincolnuni.ac.nz

Supervisors: Ed Challies, UC
Christopher Rosin, LU

Nusa Tenggara consists of small islands with steep and hilly contours, which combined with a semi-arid climate make this the driest area in Indonesia, often facing water scarcity. Moreover slash and burn farming has worsened the situation. Conservation agriculture (CA) is believed to have numerous benefits, including conserving water. In Nusa Tenggara CA is promoted to improve productivity of farming while its benefits for conserving water are less frequently promoted. Despite intensive promotion by development agencies, adoption of CA in developing countries (especially by small-scale farmers) is relatively low, often with only partial adoption. Studies of this phenomenon have shown that CA adoption from a farmers' perspective involves a broad range of factors and varies according to local context. While farmers' perspectives are important, development agencies' perspectives also play an important role in shaping farmers' perceptions and understandings of CA.

This study explores how development agencies' interest in and value of environmental benefits, particularly water conservation over increased production, and agencies' power in the design and control of CA messaging can affect farmers' adoption of CA. The study uses a political ecology approach to analyze the phenomenon through a comparative case study of CA promotion in NTB and NTT provinces. Qualitative data was collected from mid-July to September 2020 through semi-structured interviews with farmers and non-government and governmental actors involved in the CA program, and from review of available publications and documents. The research suggests that water conservation benefits are only considered when water related benefits materialize immediately, and the promotion of CA is influenced by the interests and goals of the organizations. I conclude that reflection on the agendas of development organizations in the promotion of CA is essential to identify obstacles and improve promotion of CA itself. By exploring how water conservation benefits are positioned in the promotion of CA, I would like to open further discussion on the adoption of conservation agriculture to improve water resource management in semi-arid areas, especially in Indonesia.

Research / Career Interests

- Land and water resource management in the rural setting
- Rural development, development program evaluation

About Our Platinum & Gold Sponsors



Environment Canterbury is the regional council for this magnificent region. In Canterbury we have one of the most astonishing environments in New Zealand – from the turquoise Lake Tekapo, the stunning Southern Alps, the widespread agricultural plains, and beautiful coastline – not to mention our ‘capital’ city of Christchurch – and everything in between. The regional council is responsible for this environment, with the community’s support and in collaboration with many other organisations.

The work of Environment Canterbury takes place under six broad portfolios: freshwater management; air quality; biodiversity and biosecurity; climate change, hazards, risk and resilience; transport and urban development; and regional leadership. Within these portfolios, the regional council covers such things as the Harbourmaster’s Office, regional parks, coastal erosion, buses, pest management, flood protection, and air pollution.

We can only be successful in achieving progress if we work closely with mana whenua, central and other local government agencies, businesses, industry sectors and community and volunteer groups to manage natural resources.

We are proud to support the 2020 Waterways Postgraduate Student Conference. Water is the driving force behind much of our economy and protection of this precious resource requires science to mitigate negative impact to ensure that we have a positive impact.



Hill Laboratories
TRIED, TESTED AND TRUSTED

Hill Laboratories is New Zealand's largest 100% privately owned and operated analytical testing laboratory with three major testing areas: agriculture, environmental and food & bio analytical. Tried, tested and trusted for over 30 years, our focus has remained unchanged: providing New Zealanders with the best analytical testing service on offer.

Founded in 1984 by Dr Roger and Anne Hill, the company remains family owned today. With over 400 staff working across its laboratories in Hamilton, Christchurch, Auckland, Blenheim and Wellington, it is a significant employer of science graduates from New Zealand tertiary institutions.



OUR LAND AND WATER

Toitū te Whenua,
Toiora te Wai

Our Land and Water is one of 11 National Science Challenges that focus on issues of national importance. The Challenges were designed to take a more strategic approach to the Government's science investment by targeting goals that, if achieved, will have major and enduring benefits for New Zealand.

For Our Land and Water, this means tackling the biggest science-based issues and opportunities facing our country in the area of primary production, and the complex relationship it has with our precious land and water resources.

Our mission is to preserve the most fundamental treasures of our country – our whenua, awa and associated ecosystems – while producing value from those same treasures. As a challenge, this is the ultimate. Every New Zealander, both alive today and yet to come, has a stake in the outcome.

The National Science Challenges are transdisciplinary, mission-led programmes that require collaboration between universities, Crown Research Institutes, businesses, iwi and non-government organisations to achieve their objectives.

Our Land and Water is one of the largest National Science Challenges, funded by MBIE for up to \$96.9 million over 8 years.

Our Land and Water has now begun its second phase of funding the research to deliver on our mission. To learn about future funding and research opportunities, sign up for our e-newsletter: <https://ourlandandwater.nz/news-events/> and/or see our updated research workplan https://ourlandandwater.nz/wp-content/uploads/2020/08/Research-Update-Booklet_Spreads_A5.pdf



Selwyn stretches across the Canterbury Plains, bounded by the Rakaia and Waimakariri Rivers, with Arthur's Pass National Park in the Southern Alps to the west and the Pacific Ocean to the east.

With a population of more than 66,300, Selwyn is the third largest territorial authority in the South Island, following years of sustained growth. While this growth was initially driven by relocation following the Canterbury earthquakes, it is now equally sustained by industrial and commercial movement towards the south west of Greater Christchurch. The district also supports a thriving primary production sector including dairying, assisted by ongoing irrigation investment.

Selwyn District Council is planning significant investment over the next 10 years in community services, facilities and infrastructure, including the management of our 5 Waters services – water supply, wastewater, stormwater, land drainage and water races.

The availability of clean, safe water and the safe disposal of wastewater are fundamental to the health of our community and natural environment. The Council takes an integrated approach to managing water resources, recognising that our 'mountains to sea' landscape means there is a strong connection between these services.

Much of the district lies within the catchment of Te Waihora/Lake Ellesmere, one of New Zealand's most important wetland systems, and central to the mana of Ngāi Tahu. The Council is working actively with Ngāi Tahu, Environment Canterbury and other partners on widespread cultural and ecological restoration projects.

Other priority projects include the expansion and upgrading of wastewater treatment facilities, increasing water supply capacity and the upgrade of water supply treatment plants.



Aqualinc is a specialist provider of water resource engineering and management services. Our mission is to deliver long-term socio-economic benefits through world-class water and land management.

Wise management of water resources is fundamental to sustaining both economic growth and natural environments, and increasing the health, wealth and well-being of New Zealanders. Aqualinc is committed to helping New Zealanders allocate and use freshwater in a sustainable, efficient and equitable way. Increasingly, groundwater is also being recognised as a hazard, and its contribution to flooding and liquefaction is key to better management of these hazards.

We provide New Zealand with world-class water management and water use efficiency through scientific and policy research, technology development and deployment, water engineering water management advisory services, and irrigation management services.

We enjoy making a positive difference to environmental quality and the economic well-being of communities through the projects we are involved with.

Our team of professional environmental, water resource, natural resource and irrigation engineers, hydrologists, hydrogeologists and resource management consultants, are available to help with your water and land management needs.

www.aqualinc.com myirrigation.info



The NZ Rivers Group is a technical interest group of Engineering New Zealand and Water New Zealand that formed in 2009 to provide a forum for those involved with, and with an interest in rivers, flood risk management and the operational and environmental issues of catchments and river systems. Our members include engineers, geomorphologists, hydrologists, ecologists, scientists, planners, managers and others who are passionate about the successful management of river systems across New Zealand. The key objectives of the Rivers Group are:

1. To facilitate cross-disciplinary interaction between individuals, communities and professionals involved in catchment management, flood risk management and river management throughout New Zealand;
2. To promote best practice, leadership and the sharing of technical knowledge in all aspects of catchment management, including flood risk management, river restoration and river engineering throughout urban and rural environments in New Zealand;
3. To support and promote relevant science and research in river and catchment management and to disseminate that information among professionals, academics, decision makers and the general public;
4. To promote and facilitate input into local and central government policies, strategies, standards and programmes affecting catchment and river management;
5. To assist in the integration of the principles of the Treaty of Waitangi in best practice river management.

Notes

