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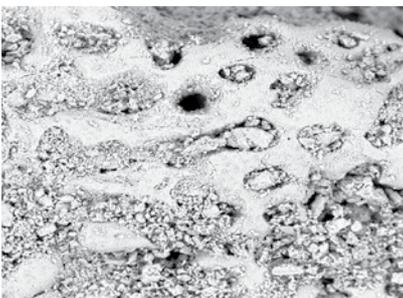
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Centre for Integrated Biowaste Research

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CIBR team planting day on 31 October

UPDATE FROM THE ACTING PROGRAMME MANAGER

Kia ora and welcome to the first newsletter of 2018.

2017 was a very successful year full of achievements within the CIBR team, we would like to thank all our collaborators for the help and support that made these achievements possible.

The Ecotoxicology group at Cawthron won a 5-year MBIE Endeavour programme to identify emerging contaminants and assess their environmental and public health risks in a New Zealand setting. Thank you to the huge number of collaborators for their support in making this happen and to Louis Tremblay for coordinating this proposal. You can find more information about this exciting project on page 2.

The Social Science group's work at Tē Pā has continued to excel (page 3), with the results of this work presented at the Tē Pā School Gala day, where we could see Jamie Ataria's prototype of the WERM, and seedlings grown in recycled pots with compost made from school waste. There is a new collaboration with the University of Canterbury, funded by Ngā Pae o te Māramatanga, to document and assess the educational and kaitiaki success of the long term work done at Tē Pā.

Jiaming Xue has coordinated a collaboration between CIBR (through Scion) and the Chinese Academy of Agricultural Sciences to investigate phyto and bioremediation of antibiotics in soils and water, and to study the impacts on antibiotic resistance. To learn more about the recently created China-NZ Soil Molecular Ecology Laboratory, and new CIBR opportunities from this collaboration, turn to page 6

The experimental plot at Lake Waikare investigating the potential of mānuka and other NZ native species to reduce the impact of farming on waterways has been successfully established. Many volunteers, including of course the CIBR team, shared their time across the planting days held in June and October (page 4).

Students play a major role in day to day work at CIBR. In this edition (page 5) we present two summer students at ESR working on mānuka projects, a new PhD student in the Soil Science group working in the framework of Scion-CAAS collaboration, and some of the results of both Bronwyn Humphries and Hazel Clemens Master's theses. Thank you all for your hard work.

Maria Jesus Gutierrez Gines



Examples of household products potentially containing emerging contaminants

A NEW MBIE PROJECT ON EMERGING CONTAMINANTS

Louis Tremblay

Chemicals play a key role in maintaining our lifestyles but many persist in the environment and can pose ecological and human health risks. Many of the household products and medicines that we use on a daily basis contribute to this issue, as some of these products contain chemicals that can accumulate in our environment.

These chemicals are termed "emerging contaminants" (ECs) and can be broadly defined as any synthetic or naturally occurring chemical not commonly monitored but has the potential to enter the environment and impact human and ecosystem health. Examples include pharmaceuticals and personal care products (PPCPs), veterinary medicines, pesticides, and industrial chemicals. The challenge is to understand and manage the potential risks these chemicals pose to wildlife and humans while maximising their intended positive outcomes.

Many members of CIBR were involved in coordinating workshops and meetings with scientists, regulators, industry and Māori to discuss the science and policy around assessing the risk of ECs from a New Zealand perspective. The strategic objectives of these discussions were to build a knowledge base, research capability, policies, and management practices appropriate to evaluate, protect and manage the risk of ECs in New Zealand. It has been recognised that there is currently a lack of policy or processes to coordinate emerging contaminant research and information management in a New Zealand setting. It was agreed that a national strategy on ECs was needed with objectives to lower the social costs and risks of ECs, minimise the release of ECs and if necessary explore lower risk alternatives, adopt a precautionary approach and prevent harm through anticipatory policies.

These efforts resulted in an MBIE Endeavour 5-year programme aiming to identify which ECs are predominant in New Zealand's aquatic ecosystems and to characterise the risk they pose to our unique tāonga (treasures). We will also investigate their potential to accumulate in food and the role ECs play in the development of antimicrobial resistance. The project has a strong focus on iwi, community, policy, industry and stakeholder engagement to raise awareness, support informed discussion and the design of practical strategies to better manage the risk and impacts of ECs in New Zealand.

The multi-disciplinary team of toxicologists, chemists, microbiologists, and social scientists will work in partnership with iwi, key community stakeholders, environmental managers and policy makers in two case-study/catchment sites: the Whau River in Auckland and catchments in Southland. The aims of this new research programme are to enhance regional and national frameworks for managing the risks of ECs in New Zealand, to safeguard our people and natural environments from their harmful impacts, and ensure that our food export products continue to meet all necessary trade requirements. The research programme structure is based on a National Strategy to manage emerging contaminants in New Zealand document which will provide a framework to assist with the identification of key issues and cohesion of resources and capability. We have also formed a National Advisory Panel including colleagues from regional councils, MfE, MPI, EPA, DOC and industry to oversee the progress of the research and ensure that it remains focused on most critical issues.

We will continue to work closely with international collaborators to focus on knowledge gaps specific to New Zealand. We continue to contribute to global initiatives such as the upcoming symposium 'What's in our water' in Canberra, 30 October-1 November 2018 (www.wiow.com.au/).

SOCIAL AND CULTURAL TEAM UPDATE

Alan Leckie, Jamie Ataria, Lisa Langer, Joanna Goven and Jinny Baker

The Social and Cultural team has been progressing its research and engagement with Te Pā o Rākaihautū, a special character school in Christchurch. Current cleaning products and other chemical usage data with changes over time have been collected at Te Pā to determine production, reuse, recycling and disposal of organic, chemical and associated inorganic wastes. Engagement with Te Pā kitchen, cleaning and janitor staff has included discussion on chemical use in their buildings and grounds and initiating a vermicomposting system. Questionnaires have been conducted with five key non-teaching staff highlighting organic kitchen waste, paper recycling, and reduction options. Suggested waste prevention opportunities have included (a) a shredder/chipper for the grounds to create a compostable mulch, close nutrient loss loops and speed up compost generation while saving money; (b) reuse of paper; (c) better food preparation management to bring food waste from the kitchen almost down to zero; and (d) eco-friendly cleaning products. These will form the basis of further research into how Te Pā will become more sustainable in all areas – important learning beyond the Te Pā school gate.

FUNDING SUCCESS

An exciting collaboration with Prof. Angus McFarlane, Dr Richard Manning and other University of Canterbury Māori Research academics is taking shape. A scoping research application submitted to Ngā Pae o te Māramatanga (NPM) by University of Canterbury Māori Research and CIBR was successful. Entitled 'Te Pā o Rākaihautū – Wetekia kia rere: Kaitiakitanga and decolonising methodologies for Māori succeeding as Māori in Education' this



Jamie Ataria & Edna discussing the model of the WERM - Worm Elimination & Recycling Mihini (also known as – The Large Te Pā Eliminator).



Alan Leckie, Maria Gutierrez-Gines and Jamie Ataria at the Te Pā School Gala Day.

research will support a multi-disciplinary and multi-organisational team of researchers and education practitioners to scope research projects that document and measure the educational successes and how kaitiakitanga (environmental guardianship) is being embedded at Te Pā. The funding pathways that will be targeted are the Marsden fund and the National Science Challenges, particularly 'A Better Start: E Tipu Rea', 'Better Homes, Towns and Cities' and 'New Zealand's Biological Heritage'. This new collaboration between the University of Canterbury, Te Pā o Rākaihautū and CIBR has already led to the submission of a chapter to an international peer reviewed book.

A NOVEL DESIGN FOR VERMICOMPOSTING

Jamie Ataria has developed a plan for a unique vermicomposting system which was inspired by the Large Hadron Collider at Cern in Switzerland. Appropriately termed the WERM (Waste Elimination & Recycling Mihini), the plan is based on a circular half-pipe where organic wastes from Te Pā's kitchen and paper waste will be fed to worms. The newly added organic waste creates a food front that the worms will actively follow and eventually process/compost leaving behind a tail of spent worm casts. These worm casts then will be collected, along with the worm juice, and used for seed raising or stockpiled for selling at the bi-annual Te Pā Gala day. The portable design will also have covered viewing ports placed at regular positions around the WERM so that pononga (students) can observe the vermicomposting process. This may also create future opportunities for other schools who have an interest in managing their organic waste streams. Te Puni Kōkiri (TPK) has been approached with a view to support Te Pā to build a prototype circular vermicomposter - an application will be lodged in early 2018.

TE PĀ SCHOOL GALA DAY AND ONGOING RESEARCH

Jamie Ataria and Alan Leckie participated in Te Pā's second 'Kai Hau Kai' Gala Day this year (all proceeds used to fund pononga attendance at the National Manu Kōrero speech competitions in 2018). CIBR supported a stand where we sold vegetable seedlings that were grown at Te Pā by the pononga. We also trialled recycled newspaper and A4 paper pots containing seedlings which were made at Te Pā and help to reduce waste and transplant shock. There were many discussions and kōrero with whānau and community, lots of kai, and even a beard trim for Alan. Acting Programme Leader Maria Gutierrez-Gines came to see first-hand the effort the Social and Cultural team are doing to make a difference at Te Pā. Both Jamie and Alan have become "he kanohi kitea" or "the seen face" for the CIBR group at Te Pā, which is an essential part in embedding CIBR's relationship with Te Pā.

HUGE THANKS TO ALL THE VOLUNTEERS FROM THE WAIKARE TEAM

Maria J Gutierrez-Gines

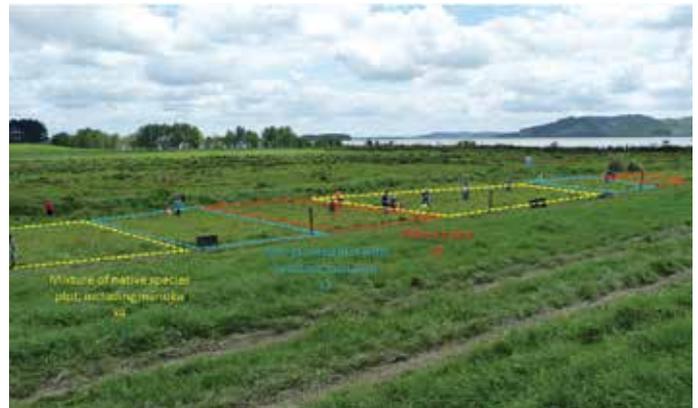
A great field experimental plot was established thanks to the help of all the volunteers that generously shared their time with us on the 29 - 31 October at Lake Waikare, this was the second planting effort to help plant a total of 40,000 native trees at Lake Waikare. This research programme seeks to investigate the potential of mānuka and other native species to reduce the impact of farming activities on the waterways, to provide diversified incomes to farmers, and to improve the cultural relationships of the communities with the Lake. The research programme is funded by Waikato River Authority, Waikato Regional Council, Vision Mātauranga Capability Fund, and ESR SSIF Funding, more information about this project was presented in the previous newsletter (Issue No. 16 Oct 2017).

From the Waikare Research Programme team, we would like to thank the help of approx. 20 volunteers from the local community. Huge thanks to the ESR-MASC crew: Kate, John, Fiona, Sally Ann, Jayshree, Amber, Brent, Anna, Nardia, Catherine, Ryan, Nishu, and Vivienne. Thanks as well to the CIBR team: Jacqui Horswell, Izzy Alderton, Vikki Ambrose, Jianming Xue, Robyn Simcock, Virginia Baker, Wim Nijhof, Lisa Langer, Alan Leckie, Jo Cavanagh, Louis Tremblay, Brett Robinson, Grant Northcott, Norman Mason, Malcolm McLeod, David Clarke (EcoQuest), Matthew Taylor (Waikato Regional Council). The team would also like to offer huge thanks to Glen Tupuhi (Nga Muka) for the enormous amount of work that he has done to bring together the efforts of all collaborators involved. We would also like to thank the farm landowner, Tawera Nikau (Nikau Estate Trust), who generously released the land for establishing the plot, and our most recent member Te Rangimarie Biddle (Matahuru Marae) for his efforts in the establishment and maintenance of the plants.

We envisage that this experimental plot won't just be resource for the Lake Waikare research programme but that it will also be a scientific resource for CIBR researchers to perform further investigations about plant behaviour and biology, species interactions, ecological restoration, community dynamics, contaminant and nutrients fate and movement in environment etc.



ESR – MASC team volunteer planting day on 30 October



Experimental design of the field plots



CIBR lunchtime lecture on the Waikare research programme given by Dr Brett Robinson

STUDENTS OF CIBR

CHARLOTTE SITZ – ESR

Charlotte Sitz is a summer student visiting from Clermont-Ferrand, France to gain some work experience in an English speaking country and to visit New Zealand. She is studying at the ENSAIA, an engineering school in France, in main field agronomy and has planned to specialise in environmental science in her last year. Charlotte is undertaking an internship at ESR to both improve her knowledge and understanding of environmental science and to learn new scientific skills and techniques. She is currently involved with a number of CIBR projects: she has participated in a large sampling campaign at 'The Pot' (Land application of treated municipal wastewater at Levin, Issue 16, October 2017). She is also working in the laboratory completing sample preparation and extractions of soil samples, and in identifying fungi in building insulation materials (BRANZ co-funded projects). Outside of work at ESR, Charlotte uses her time to go travelling around our beautiful country.



Charlotte Sitz (left) and Sky Halford (right)

SKY HALFORD - ESR

Sky Halford is a master's student at ESR working on the mānuka projects that ESR currently has. Sky has a Bachelor's Degree in Environmental Science and Physical Geography where she worked on projects including charcoal and grainsize analysis in sediments from Lake Pounui, Wairarapa, and water quality testing in the Whangaehu catchment originating from Mount Ruapehu.

Sky is currently doing her Masters in Environmental Studies at Victoria University of Wellington, with her thesis is looking at the role of mānuka in enhancing provisioning, regulating, and cultural ecosystem services at Wairarapa Moana (Lake Wairarapa). Her thesis is separated into investigating provisioning and regulating ecosystem services - How might mānuka as a species improve soil and freshwater quality in the area (provisioning service), and how can a manuka dominated riparian zone enhance the filtration of contaminants and act as a carbon sequestration tool (regulating service). These themes will be explored using:

- A field study with 10,000 Mānuka plants that is already underway, set at Wairarapa Moana, to measure changes in *E. coli*, nitrogen and phosphorus leaching.
- A greenhouse experiment based at ESR that mirrors the field trial comparing mānuka and black beech (two rongoā species found in the region), willow (recommended by regional councils for riparian management), and pasture (control).
- Analysis of lake sediments from Wairarapa Moana to attain a historic record of land management around the lake.

Cultural ecosystem services that could be provided through the use of mānuka will be explored using interviews and focus groups. This involves working with Ngāti Kahungunu ki Wairarapa to gain an understanding of the spiritual values, oral histories, and iwi perspectives on future management of the lake. Cultural ecosystem services also incorporates recreational capacity, cultural heritage and sense of place, thus working with recreational groups and local community will be crucial to investigate also. The perspectives of nearby landowners and Greater Wellington Regional Council will also be invaluable, as they are directly involved in management of the lake. This project is highly collaborative in nature, and is in conjunction with CIBR, ESR Greater Wellington Regional Council, Ngāti Kahungunu ki Wairarapa, GNS Science and Victoria University of Wellington.

During her spare time Sky works for Victoria University of Wellington, tutoring students in the School of Geography, Environment, and Earth Sciences, and the School of Management.

YUANWANG LIU - SCION/CAAS



Yuanwang Liu, a PhD student at CAAS in Beijing, China..

Yuanwang was an excellent Master graduate from Chinese Academy of Agricultural Science (CAAS), with three publications in international journals (see below) and one in a Chinese core periodical. He commenced his PhD study at CAAS in November 2017. Currently, he is completing a literature review and drafting his research proposal. Built on his Masters study, he would like to study the changes of relative antibiotic resistance genes and mobile genetic elements during the composting of gentamicin fermentation residues and their relations with the dynamics of bacterial community structure and function.

- Liu, Y.W., Feng, Y., Cheng, D.M., Xue, J.M., Hu H Y, Li, Z.J*. Gentamicin degradation and the changes in fungal diversity and physico-chemical properties during composting. *Bioresource Technology*, 244 (2017) 905-912. (IF:5.651)
- Liu, Y.W., Chang, H.Q., Li, Z.J.*, Zhang, C., Feng, Y., Cheng, D.M., Xue, J.M.. Biodegradation of gentamicin by bacterial consortia AMQD4 in synthetic medium and raw gentamicin sewage. *Scientific Reports*, 2016, 6, 35856; DOI: 10.1038/srep35856 . (IF:4.259)
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VIRUS TRANSPORT FROM ON-SITE WASTEWATER TREATMENT SYSTEMS

Hazel Clemens. Masters student – ESR

Discharge of domestic wastewater from on-site wastewater treatment systems (OWTS) releases pathogens to land via disposal fields and land application systems. These pathogens, including viruses, enter the soil and may be transported through soil into groundwater posing a risk to public health. The viruses in OWTS wastewater discharged to land may contaminate drinking water wells. This is of particular concern in areas where discharges from OWTS are in close proximity to these wells. My Master's research is investigating how viruses are

transported from OWTS through the soil below. I am examining how viruses move through free-draining Canterbury soils to understand the risk of groundwater contamination. So far results indicate the widely used tracer, MS2 phage appears to behave quite differently to the pathogenic virus, rotavirus. This has implications for the current Guidelines for separation distances between OWTS and wells, which may be overly conservative.

UPDATE FROM THE SOIL SCIENCE GROUP

DEVELOPING CIBR'S RESEARCH CAPABILITY IN BIOREMEDIATION OF ANTIBIOTIC POLLUTION IN SOIL AND WATER THROUGH COLLABORATION WITH CHINESE COLLEAGUES

By Jianming Xue, Soil Science Group Leader

Antibiotics are considered an emerging contaminant and antibiotic pollution of waterways has become a global environmental problem, threatening aquatic environments and human health worldwide. In both China and New Zealand (NZ) there is a pressing need to address this issue through sustainable approaches for bioremediation of aquatic ecosystems, which are the main conduit of antibiotic residues in the environment and reservoirs of antibiotic resistance. A major pathway of antibiotic release into the environment is through land application of animal manures or biosolids and wastewater discharges, which causes the spread and impact of both antibiotic residuals and antibiotic resistance genes. To tackle this problem, collaborative research between the two countries are warranted to address the current lack of management options by developing remediation strategies and technologies to enhance the breakdown of antibiotics and remediation of contaminated sites.

Dr Jianming Xue at Scion (a Crown Research Institute and a key research partner at CIBR) has established a strong collaborative relationship with Prof Zhaojun Li and his team at the Chinese Academy of Agricultural Sciences (CAAS), building on linkages developed from an initial scientific exchange fostered through "NZ-China Scientist Exchange Programme" in 2015. As a result of the exchange, a memorandum of understanding (MOU) between CAAS and Scion has already been signed and the "Joint Laboratory of Soil Molecular Ecology" has been established by the two organisations for long-term research collaboration and co-training of Chinese students.



Dr Jianming Xue gave a seminar at the Institute of Agricultural Resources and Regional Planning, CAAS in Beijing in Sept 2016.

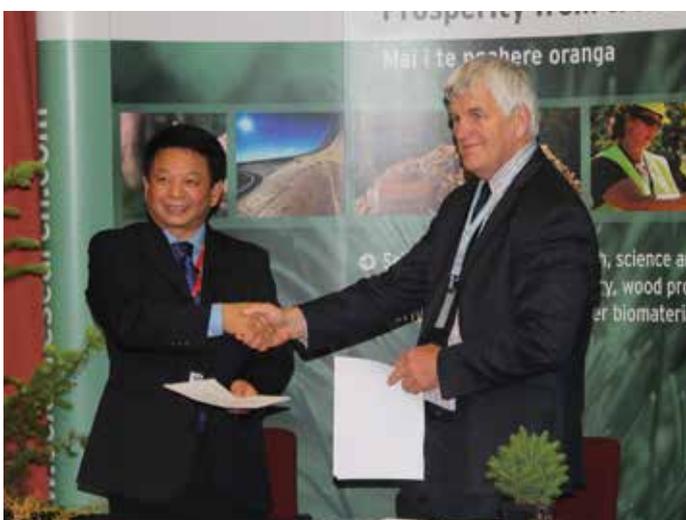


To encourage the beneficial use of animal manures or biosolids in agriculture and forestry and effectively reduce the point-source and non-point source pollution, the collaborative research has focused on:

- Developing an enhanced antibiotic degradation manure composting system by incorporating biochar or other functional materials.
- New ozone/UV and other catalytic oxidation technologies for remediation of animal wastewater
- Novel phytoremediation systems for wetland and upland soils by selecting specific plant species.

Key advantages of collaborating with CAAS are that Prof Li leads China's national antibiotic pollution remediation research programme, with a wealth of expertise and has state-of-the-art facilities and infrastructure. He and his team have excellent research records in several areas that are critical for developing CIBR's research capability in bioremediation of antibiotic pollution in soil and water. For example, they are experts in: antibiotic removal from agricultural and pharmaceutical wastes and soils by using novel fungal strains or bacterial consortia, along with determination of multiple antibiotics in the environment. Finally, they are highly experienced in the application of in-situ and large-scale bioremediation technologies. The added value of this collaboration is to combine complementary skills to rapidly develop remediation technologies for antibiotic pollution and antibiotic resistance genes. This research collaboration forms the basis of future collaborations between CIBR and CAAS building on the MOU signed between CAAS and Scion.

Building on the current research collaboration, CIBR's soil team led by Dr Jianming Xue and microbiology team led by Dr Louise Weaver are going to collaborate with CAAS and other key Chinese research partners for a NZ-China joint research programme. This will facilitate long-term collaborations between NZ and Chinese scientists to develop a coherent research strategy that will lead to novel bioremediation technologies to aid in the removal of antibiotics and the restoration of aquatic environments contaminated with antibiotics so as to reduce the spread and impact of antibiotic resistant genes within aquatic ecosystems.



The signing ceremony of the MOU between CAAS and Scion for China-New Zealand Joint Laboratory for Soil Molecular Ecology in Rotorua, New Zealand on 10 Nov 2015.



Dr Jianming Xue visited the research facilities at the Institute of Environmental Sciences, CAAS in Beijing in Oct 2017.

We will identify the extent of antibiotic residues present in wastewater (municipal and livestock) and aquatic receiving environments and investigate the potential for bioremediation using native aquatic plant-microbe interactions through an initial survey. A multidisciplinary team will be assembled to develop innovative approaches to tackle the antibiotic pollution and resistance issues, with expertise spanning from the fate and transport of contaminants in ecosystems, quantification of emerging contaminants and antibiotic resistance genes in the environment, evaluation of ecological risks associated with antibiotic resistance, plant-associated microbial degradation, phytomanagement strategies, and the restoration of aquatic environments polluted with antibiotics.

The expected outcomes of the joint research programme can be better coordinated and targeted collaborations between the two countries, creation of novel technologies for robust, cost effective and sustainable remediation of antibiotic residues in aquatic environments, establishment of enduring partnerships, development of advanced mitigation strategies to reduce water contamination by antibiotics, increased cultural understanding, enhanced Māori engagement with China, and increased awareness of NZ as a centre of excellence in research and development in restoring ecological resilience of aquatic environments.

Dr Jianming Xue is the Soil Science Group Leader at CIBR and the NZ Director for the China-NZ Joint Soil Molecular Ecology Laboratory between CAAS and Scion. He has co-supervised three Master students and is co-supervising one PhD student at CAAS. His research collaboration with Prof Li at CAAS has produced seven scientific publications to date.

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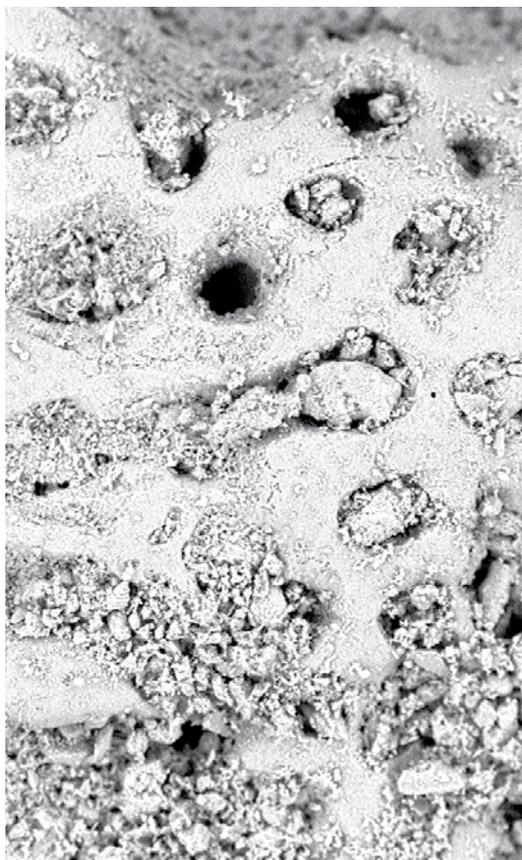
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EXAMINING CORAL SAND FOR THE TREATMENT OF DOMESTIC EFFLUENT IN KIRIBATI

Bronwyn Humphries

Masters of Water Resource Management
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This novel study examined the microbial removal properties of coral sand to explore how it might be applied to onsite wastewater treatment in Kiribati. Laboratory based, unsaturated drainage experiments were undertaken using worked coral beach sand, to examine its drainage and effective microbial removal properties. Bacterial and viral indicators (*E. coli*, *E. faecalis* and MS2 phage) along with viral pathogens (adenovirus; echovirus; norovirus; rotavirus) were drained under gravity through coral sand-packed columns, serving as physical models of an effluent drainage field. The results show that coral beach sand has a higher affinity for viruses than bacteria. All organisms examined showed removal efficiencies over 4-log removal values (i.e. 99.99 % reduction). Attenuation mechanisms such as absorption and physical straining likely play a major role in the ability of coral beach sands to attenuate the microbial tracers used in this study. Field studies are required to verify the laboratory results. These findings could have important implications for the use of locally available materials, such as coral sand, to improve household onsite wastewater treatment in Kiribati and offer enhanced protection of groundwater resources and reduce diarrheal disease.



Scanning Electron Microscope (SEM) image of Bikenibeu beach coral sand.

If you would like to subscribe to this newsletter please email Izzy.Alderton@esr.cri.nz with your contact details.

If you would like further information on the programme or have any questions, please see our website www.cibr.org.nz or contact a member of the Science Leadership Team:

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2018 NZ Land Treatment Collective Annual Conference

7th–9th March 2018 Rotorua Energy Events Centre
(Downer and Sigma rooms)



NZLTC CONFERENCE 2018

Bronwyn Humphries

The NZLTC 2018 annual conference will be held at the Rotorua Energy Events Centre, from the 7 – 9 March. This year's conference theme is: 'Benefits and risks of land treatment', with a special session on 'Land treatment and climate change'. These themes will allow presenters to explore the complex nature of land treatment alongside the challenges that climate change presents. Alongside 23 oral presentations given by conference delegates the conference will also include an expert panel discussion on the key challenges facing the waste sector in the next 10–20 years. The fieldtrip on Friday 9 March is shaping up to showcase some of the innovative land treatment sites around Rotorua including the OSET (On-site Effluent testing) trial facility.

Guest speakers include:

- Iain White (NIWA) - What is climate change?
- Rob Bell (MPI) Impact of Climate Change on land use
- Sally Brown (University of Washington) International speaker, biosolid management
- Chuck Henry - International speaker, Toilet innovation

For information on how you can become a conference sponsor or to secure one of the 10 trade displays on offer please contact Louise Weaver: nzltc@esr.cri.nz

See our website for more details: <https://nzltc.wordpress.com/events/nzltc-annual-conference/>

