Welcome to the Soil News

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In this issue...

Your contributions are required - New Zealand Soil News is your newsletter

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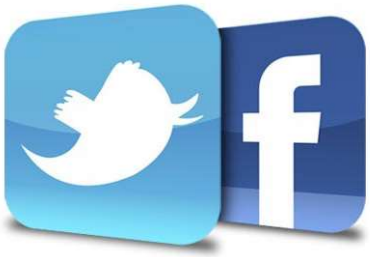

Have you liked us on Facebook?
The NZSSS has a Facebook page and Twitter handle (@NZ_Soil_Soc). If you are already a user, please follow us. You can also keep an eye out for new NZSSS posts by checking the feed from our website

Officers of the NZSSS 2020-2022

President: Tim Clough, Lincoln University
Vice President: Sam Carrick, Landcare Research
Past President: Megan Balks, University of Waikato
Secretary: Diana Selbie, AgResearch
Treasurer: Haydon Jones, Waikato Regional Council

Council: Brendan Malcolm, Plant & Food; Chris Anderson, Massey University; Tanya O'Neill, University of Waikato; Pierre Roudier, Landcare Research; Paul Johnstone, Plant & Food; Natalie Barlett, AgResearch Ruakura

From the Editor

Kia ora tatou
Gina Lucci has been the editor of Soil News since November 2017. In that time, she has put together many issues of Soil News for us. Gina and Isabelle Vanderkolk work together to get Soil News out to readers. Many thanks also, to our Soil News correspondents who supply many interesting items. Gina has handed over the reins to John Drewry, who will continue to work with Isabelle. Many thanks Gina for all your efforts.

Society News

Prepared by Megan Balks using survey results collated by Groundworks and Associates

Introduction

The Council of New Zealand Society of Soil Science (NZSSS) conducted an online member survey in late 2020. The aim of the survey was to collect information for use by NZSSS Council for strategic guidance and determining resource use for the benefit of NZSSS members. Our thanks to the large number of members who participated in the voluntary online survey and to Groundworks for advice on, and undertaking, the survey and collating the results.
The conclusions/recommendations of Council are given below, followed by a brief summary of key results.

Overall conclusions/recommendations

1. Strong support for current priorities and activities of NZSSS, particularly conferences, including joint one with Australia, support for students to attend conferences, and soil news. No major changes required.
2. Facilitating communication between members and supporting professional collegiality in soil science is most important in an increasingly interdisciplinary world
3. Plan to introduce a major early career researcher (ECR) award, along with ECR conference presentation awards, and more events targeting ECRs

4. There is support for increased engagement with schools and younger students – science fair prizes and judging, careers in soil science info, general soil info to support teachers – dependent on volunteers to help.
5. More regional field/workshop activities/farm days – can be for members and outreach to wider community – World Soil Day events. Need volunteers to help.
6. A few minor tweaks/suggestions for Soil News
7. Room to improve website – need volunteers to help
8. Our thanks to people who expressed an interest in being more involved in NZSSS by organising local events, being on council, writing submissions, interacting with media, or other activities… we will be in touch to discuss ways in which you might like to help. **If anyone else would like to volunteer to get more active in the NZSSS, you are more than welcome – talk to any council member or email the President, Tim Clough, at timothy.clough@lincoln.ac.nz**

Summary of key survey results:

Society objectives (from NZSSS rules legal document)

a. All objectives were predominantly rated as fairly, or very, important.
b. A couple of comments suggested more emphasis on young researchers and on public promotion of soil science and sustainable soil management.
c. **CONCLUSION: Our objectives are appropriate and stand up to scrutiny – no changes required.**

Society communication means

a. Most highly rated were biennial Conference and Soil News
b. Next most highly rated were NZSSS emails, chats with colleagues, and local NZSSS meetings
c. Most other means of communication had a wide range (bell curve) of responses; from important to not at all important including IUSS info, other prof meetings, NZSSS website, twitter and FB.
d. **CONCLUSION: seems our current emphasis is about right. Emails are probably the best way to reach all members with important timely information. We should consider more regional, informal and cheap to run meetings to enable social networking etc in this travel restricted era.**

Priorities for society resource use

a. Clear majority consider our Biennial meeting, regional meetings, and soil news as top priorities.
b. Many suggested no change to what we do.
a. Muted support for website, social media and email notices.
b. Priorities for expenditure: All suggested areas had a wide range of response from high to low priorities.
c. Support for students to attend conferences had the highest level of positive response.
c. **CONCLUSION: people predominantly support our current major activities.**

Media and policy interactions

a. Strong support for NZSSS to be proactive on soils of high value for food production and sustainable soil management.
b. Mixed opinions on other issues such as scientific uncertainty, independence of scientists, assisting public understanding and seeking opinion of the membership on issues before going public.

Relations with other professional societies.

a. Many of our members also belong to other prof societies, in approx. order of numbers: NZARM, NZGA, NZIAHS, Hydrosoc, RSNZ, GSNZ, NZIPIM
b. Strong support for joint Aussie SSS conference every 4 years
c. Muted support for other joint meetings or collaborations.
d. Comments that as soil science work is increasingly interdisciplinary NZSSS role is more important as maintains a soil focus/opportunity to interact with like- minded people.

How can NZSSS support member career development/add value for members

a. Increase support for early career scientists – possibilities include a rep on council, network, space in conferences consider some activities in conferences for students and ECRs.
b. Workshops with relevant professional training.
c. More fieldtrip/workshops
d. Webinars on topics of interest/network building…
e. Help foster sense of collegiality/professionalism/membership of Soil Science community

Member involvement

a. 1/3 of respondents said they would like to be more involved in NZSSS
b. 17% interested in serving on council
c. 39% interested in local branch actions
d. 36% contributing to submissions
e. 20% World soils day events
f. 11% Social media
g. 33% Soil news correspondent
h. **Recommendation – we follow up with these people and facilitate them getting involved!**

Some specific general comments that we should note and/or enact

a. Please put links to papers where abstracts appear in Soil News
b. Soil news is important for techs who do not always get to go to conferences – *opportunity to include more material of relevance for technicians*
c. Website could be greatly improved and more links from soil news to website for useful info…
d. More communication with wider (farm etc) community – maybe organise more farm field days with soil emphasis. *Could be local branch activities for members and others? World soils day activities but hold in November or February as December is too busy for many…*
e. Interaction with schools
f. Add in early career awards and consider awards for conference presentations for all, and not just students.

DEMOGRAPHICS

Age and sex distribution of respondents

a. 20-30 6.5%
b. 31-40 21%
c. 41-50 16.0%
d. 51-60 27.4%
e. 61-70 22.6%
f. 70 + 6.5%
g. M 69%, F 24% no comment 6%

Regional distribution of respondents

h. Waikato 37%
i. Canterbury 34%
j. Manawatu-Whanganui 13%
k. Northland 3%
l. BOP 3%
m. Wellington 3%
n. Hawkes Bay 2%
o. Taranaki 2%
p. Marlborough 2%
q. Otago 2%

Qualifications of respondents

r. PhD 68%
s. Masters 23%
t. Uni Dip 2%
u. Bachelors 8%

Organisation

a. CRI 40%
b. Uni 15%
c. Regional or district council 15 %
d. Private coy 10%
e. Fert industry 7%
f. from Central govt 2% ,
g. independent research 4%,
h. Retired 5%

Occupation

i. Research 34%
j. Applied science 19%
k. Consultant 11%
l. Uni academic 8%
m. Student 3%
n. ECR 3%
o. Tech 3 %
p. Retired 5%
q. 10 others…. Post doc, policy, team leader, GIS, ….

Invited Opinion

Testing the boundaries to circumvent policy that aim to protect our best land and soils

By Fiona Curran-Cournane

Land use pressures confronting some of our best land and soils in Aotearoa New Zealand, such as land fragmentation and development, have garnered a lot of media attention[1],[2] in recent weeks, largely commencing with the release of Our Land 2021. Prior to the release of Our Land 2021, a more comprehensive analysis of these pressures in New Zealand and select regions, spanning a 17-year time period, was being undertaken by the Ministry for the Environment, Manaaki Whenua, Waikato Regional Council and Statistics NZ, and has just been recently published, (https://www.tandfonline.com/doi/full/10.1080/00288233.2021.1918185) creating another wave of interest[3],[4].

Where Councils 'draw' residential and development zonal boundaries is indeed important but it is not the full picture as far as our unique land and soil characteristics are concerned. From on-the-ground experience, landowners with the desire to subdivide or rezone their land for development purposes outside of such zonal boundaries tend to typically present the same suite of common arguments when trying to circumvent policy.

My first encounter of such experiences began with the 361 hectare 'Drury South Private Plan Change' in 2011 – shortly after my commencement as a land and soil scientist at Auckland Council. Assisting Dr Douglas Hicks in the field, it took us about 3 days in the field to map according to the Land Use Capability (LUC) classification. My last encounter to date in late 2019 involved assisting Dr Reece Hill in the field mapping 32 hectares of land associated with the 'Patumahoe South Private Plan Change'. In between my first and last encounters required a fair amount of other expert witnessing on similar matters related to our best land and soils for various resource consents, as well as hearings associated with the Auckland Unitary Plan Independent Hearings Panel and the Environment Court more recently.

The following aims to provide a short outline of a couple of standard landowner arguments who are motivated to subdivide and develop their best land and soil – as well as counter-arguments to aid with fully informing the decision making process.

- A very common argument a landowner will present to decision makers is that the land in question, whether it's 4, 40 or 400 hectares etc. in size, only amounts to 0.000X% - 0.00X% of the total available area of LUC Class 1, 2 or 3 land for the region. To balance such an argument, it is imperative that decision makers are equally presented with evidence on the cumulative effects of development and fragmentation pressures confronting highly versatile (Class 1 and 2) and highly productive (Class 1-3) land. In such

cases, the isolated case would no longer appear so insignificant and ultimately only adds to the cumulative loss.

This worked in favour for the protection of roughly 80 hectares of mostly Class 1 and 2 land (mapped at the farm-scale) in Auckland during an Environment Court re-hearing in 2020. For example in Auckland, at least 34%, 38% and 19% of Class 1, 2 and 3 land has been occupied by legacy zones as well as Auckland Unitary Plan 'live zones'[5]. Providing such evidence helped render the landowner's 'insignificant' loss to be more substantial than that presented as an isolated case.

- Another common argument is a landowner presenting a case that their block of land as no longer being 'economically viable' – whether or not it was used commercially in the first place or, and in many cases, was occupied as a lifestyle block (or for land banking purposes). Such arguments get very subjective very quickly because – and land and soil characteristics being equal, one landowner can argue one way while a neighbouring property can argue otherwise depending on the motivation of the landowner – to farm or to subdivide.

Instead of going down this rabbit hole, it is important to bring it back to the 'potential' of the land as opposed to the 'actual' current land use. This distinction between actual and potential high-value soils for food production was recognised in the previous Town and Country Planning Act (1977). This Act gave way to the RMA in 1991 which makes no specific mention of versatile or high class land – rather uses phrasing such as '*safeguarding the life supporting capacity of air, water, soil and ecosystems*'. Regardless, it is still incredibly relevant to stress this distinction to decision makers and raise awareness that it's the potential of our best land and soil that needs to be preserved to maintain future options – to provide room for food and fibre industries to continue production and manoeuvre to operate in future markets.

One of the bigger pills I ever had to swallow was reading the Auckland Unitary Plan Independent Hearings Panel recommendation to rezone hundreds of hectares, if not in the thousands of hectares, of Class 2 and 3 prime agricultural land from 'Mixed Rural' to 'Countryside Living' in west Auckland – in the already largely fragmented vicinity of Coatesville, Kumeu, Whenuapai and Riverhead. Despite Horticulture New Zealand previously identifying the area as being of significance in terms of horticultural production, this was a hearing that saw landowners in the area coming out in vast numbers claiming their blocks of land as no longer being 'economically viable' and suggesting subdividing was the only option to make any form of return. This was another case where it was hard to determine whether the blocks of land in question were being used for commercial primary production purposes, or what appeared to be for lifestyle living purposes when teasing through their statements of evidence. It was only a couple of years later that the FARMLUC Classification became available for Auckland[6] that identified a large proportion of the area as occupying Class 1 land – which would now see it being subdivided down to 2 hectares, or 1 hectare sections if a suite of certain criteria are met.

These are by no means new arguments tested by landowners that many of the soil science community will be familiar with, and perhaps more will be confronted with as a potential 'gold rush' is currently being felt prior to the release of any decisions being made on the proposed National Policy Statement for Highly Productive Land. Such decisions are expected to be made by Ministers and Cabinet in the next half of this year – but even if approved by Cabinet, it will unlikely mark the end of age-old arguments to circumvent policy. From experience, the policy intent and wording will need to be pretty watertight and I'm therefore of the opinion that it needs to avoid being flexible and subjective which can lead to cracks that can eventuate to gaping holes.

After 10 years of observations, involvement and experience with these land use issues in Auckland it is easy to start to become desensitised which is concerning in itself. It is not until you converse with other members of the soil science community in other regions that reminds you again about the seriousness of these pressures. With increasing uncertainties surrounding our natural resources such as water scarcity, climate change as well as current and future global pandemics, it's a no-brainer to even everyday citizens to preserve our best land and soils in order to protect our resilience, as well as the resilience of future generations. It's the latter that is probably the biggest pill of all to swallow – with three kids ranging from four months-to four years old – intergenerational equity really starts to resonate more than ever providing further motivation to help continue bring these matters to light until we are somewhat sure of effective intervention.

Dr Fiona Curran-Cournane – Ministry for the Environment

Biography – Fiona has been employed as a principal scientist at the Ministry for the Environment since 2020. Prior to that, she spent nearly nine years as a land and soil scientist in the Research and Evaluation Unit at Auckland Council, upgrading to senior scientist in 2018. She has interests in the incorporation of science into policy formulation. Research interests include the evaluation of development pressures onto land and soil, understanding how such changes affect rural and farming communities, and interconnections with the wider food system. Having moved to Aotearoa New Zealand from Ireland in 2007, she undertook a PhD in Environmental Science at AgResearch via Lincoln University. Being a Paddy, it would be safe to assume that she is naturally biased towards anything that grows a decent spud.

[1] An eroded environment under pressure and the loss of productive land, new report reveals (April 2021) https://www.rnz.co.nz/news/national/440519/an-eroded-environment-under-pressure-and-the-loss-of-productive-land-new-report-reveals
[2] Houses v vegetables: Productive farmland 'lost to lifestyle blocks' (April 2021) https://www.stuff.co.nz/business/farming/124916274/houses-v-vegetables-productive-farmland-lost-to-lifestyle-blocks
[3] Rural Today Magic Talk 19 May 2021. Rural Today Catch up Podcast – Magic Talk – 19-5-2021 https://www.magic.co.nz/home/shows/talk/newshub-rural.html
[4] Lifestyle block sprawl threatens to the most productive land, researchers say 06 May 2021. https://www.stuff.co.nz/business/farming/125038324/lifestyle-block-sprawl-threatens-to-the-most-productive-land-researchers-say

[5] Curran-Cournane, F. (2019). "Evidence in Chief of Dr Fiona Curran-Cournane on behalf of Auckland Council before the Environment Court at Auckland ENV-2016-AKL-304-000199. 20 December 2019."

[6] Hicks, D. L. and V. Vujcich (2017). "Farm-scale land use capability classification for Auckland. Auckland Council Technical Report TR2017/016."

Editor's note
Further information on land fragmentation is available in Fiona's paper, just published. The abstract is at the end of Soil News. The paper is: Curran-Cournane F, Carrick S, Barnes MG, Ausseil A-G, Drewry JJ, Bain IA, Golubiewski NE, Jones HS, Barringer J, Morell L 2021. Cumulative effects of fragmentation and development on highly productive land in New Zealand. New Zealand Journal of Agricultural Research (On-line early, open access): 1-24.
https://doi.org/10.1080/00288233.2021.1914688

Several in-text links did not convert into the pdf – here they are repeated:
Link to article: Environment Court re-hearing in 2020
https://www.stuff.co.nz/national/politics/local-democracy-reporting/300225717/urban-sprawl-projected-to-eat-up-some-of-aucklands-most-productive-land
Our Land 2021: https://environment.govt.nz/publications/our-land-2021/

New Book Launch

Venerating our soils

Invitation to attend the launch of the new book "The soils of Aotearoa New Zealand"

All those with an interest in soil science, and especially the soils of New Zealand and their origins, properties, distribution, and management, are warmly invited by Professor Margaret Barbour, Dean of Science, to the University of Waikato's School of Science/Te Aka Mātuatua book launch "Venerating our soils".

The book by Allan Hewitt, Megan Balks, and David Lowe, published in February this year by Springer, will be formally launched at 2.15 pm on the opening day of the joint conference of the New Zealand Society of Soil Science and Soil Science Australia (Monday 28 June 2021), which is being held simultaneously in two hubs, one in Cairns and one at the University of Waikato, Hamilton (together with virtual participation).

Notes about the book are given below.

The **Right Honourable Simon Upton,** Parliamentary Commissioner for the Environment, will speak at the launch.

Light refreshments will be served at the conclusion of the formal launch.
To attend the launch, which is scheduled from **2.15 to 2.45 pm on Monday 28 June, 2021**, could you please indicate your participation by registering with **Dr Tehnuka Ilanko** at tehnuka.ilanko@waikato.ac.nz and include any special dietary requirements. Registrations should be received by Monday 21 June, 2021 (the earlier the better).
The launch will be held on the upper (first) floor of the **S block lecture theatre complex** on the University of Waikato campus, Hamilton. S block can be accessed from ether Hillcrest Road or Knighton Road (see map at http://www.waikato.ac.nz/contacts/map/)

For further information, email Dr Tehnuka Ilanko at tehnuka.ilanko@waikato.ac.nz

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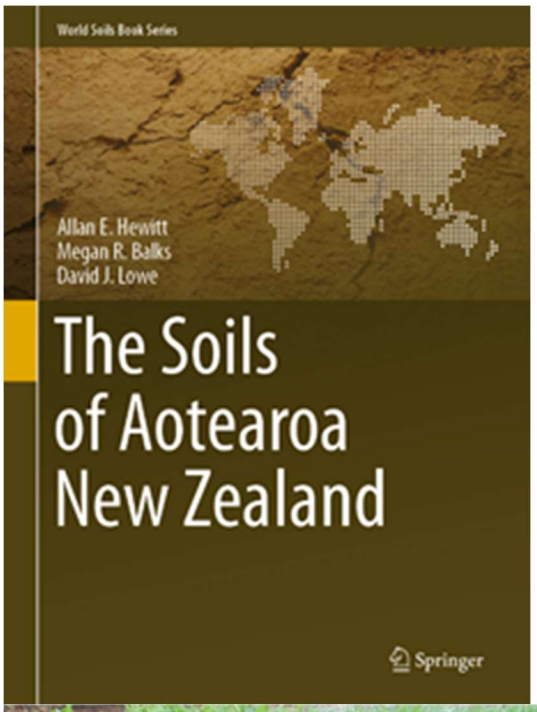
New book on soils of Aotearoa New Zealand

Dr Megan Balks and **Prof David Lowe** (both from the Earth sciences group, School of Science, University of Waikato, Hamilton) have teamed up with **Dr Allan Hewitt** (Manaaki Whenua-Landcare Research, Lincoln) to write a book on the soils of New Zealand. Published by Springer in February 2021, and part of the World Soils Book Series (WSBS), the book is the first general text on the soils of New Zealand to be published in more than 30 years.

It is the only book available that describes New Zealand's soils in the context of the *New Zealand Soil Classification* (*NZSC*) (developed by Hewitt) that has been used in New Zealand since 1992. For international readers, the book includes equivalent



terms for *NZSC* classes using the international soil classification systems, *Soil Taxonomy* and *World Reference Base*.

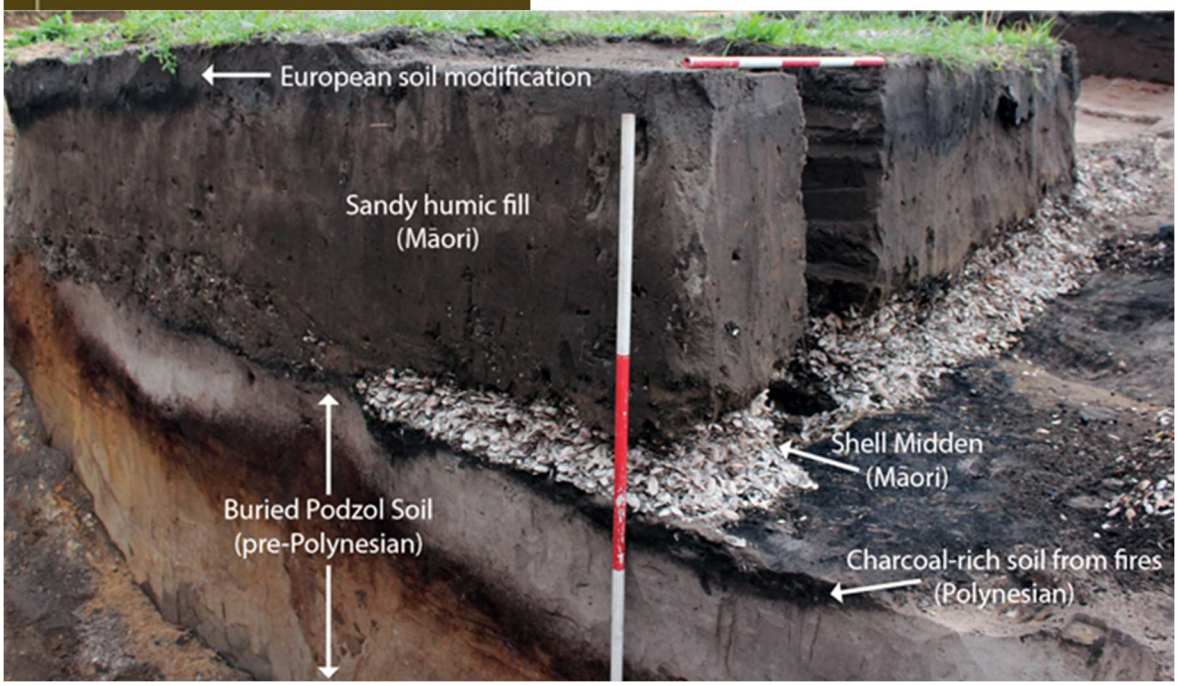


Illustration from the book's chapter on Anthropic Soils (Ch. 3) showing a beautiful and informative layered soil (Artifact Fill Anthropic Soil in NZSC) over a buried Podzol Soil at an early 17th century site at Cooks' Beach on the eastern coast of Coromandel Peninsula (Hoffmann 2017). Photo: Andrew Hoffmann.

The book provides an up-to-date overview to the soils of New Zealand structured according to *NZSC* and encompasses 18 chapters. Starting with an introduction on the importance and distribution of New Zealand soils (Chapter 1), it subsequently provides essential information on each of the 15 New Zealand soil orders in separate chapters (Chapters 2 to 16). Each chapter includes a summary of the main features of the soils in the order, and their genesis and relationships with landscapes – which

may include an evaluation of Quaternary environments and a stratigraphic approach to underpin the 'competing' geological and pedological processes involved in upbuilding pedogenesis that predominate in a number of orders. The key properties including examples of physical and chemical characteristics of the soils, and their classification, use, and management, are also included in each chapter.

The book then features a chapter (Chapter 17) on soils in the Ross Sea region of Antarctica (with which New Zealand has had a >100-year-long explorative and scientific connection) and concludes (Chapter 18) by considering New Zealand soils in a global context, by examining soil-formation pathways, and by covering methods used in New Zealand to evaluate soils and assist in land-management decisions. A detailed 14-page index completes the volume. Every chapter also includes a 200-word abstract.

The authors' aim has been to provide a clear, modern and reasonably detailed account of New Zealand's soils for undergraduate and graduate students, land managers, farmers, and those with an interest in New Zealand's natural history and landscapes. All chapters are written by the three authors, which helps to maintain a continuity of style and coherence, whereas many other books in the WSBS comprise edited volumes with multiple authors each contributing chapters.
The book comprises 332 pages with 192 illustrations (147 in colour). It is available as a hardcover or e-book, or e-chapters can be purchased individually.

David Lowe (david.lowe@waikato.ac.nz) can provide a pdf of the table of contents in their entirety if such information is needed.

Publication details

Hewitt, A.E., Balks, M.R., Lowe, D.J. 2021. *The Soils of Aotearoa New Zealand* (1st ed). Springer, Cham, xx + 332 pp. DOI: 10.1007/978-3-030-64763-6

Reference

Hoffmann, A. 2017. Investigation of archaeological site T11/2789, Cooks Beach (Pukaki), Mercury Bay: final report. *HNZ authorities 2015/867 & 2015/1022*. 123 pp.

Availability of book

Springers' website for more information and purchase options: https://www.springer.com/in/book/9783030647612

Articles

Special issue of *Dokuchaev Soil Bulletin* to commemorate the 175th anniversary of the birth of V. V. Dokuchaev

A note from David Lowe (Univ. of Waikato)

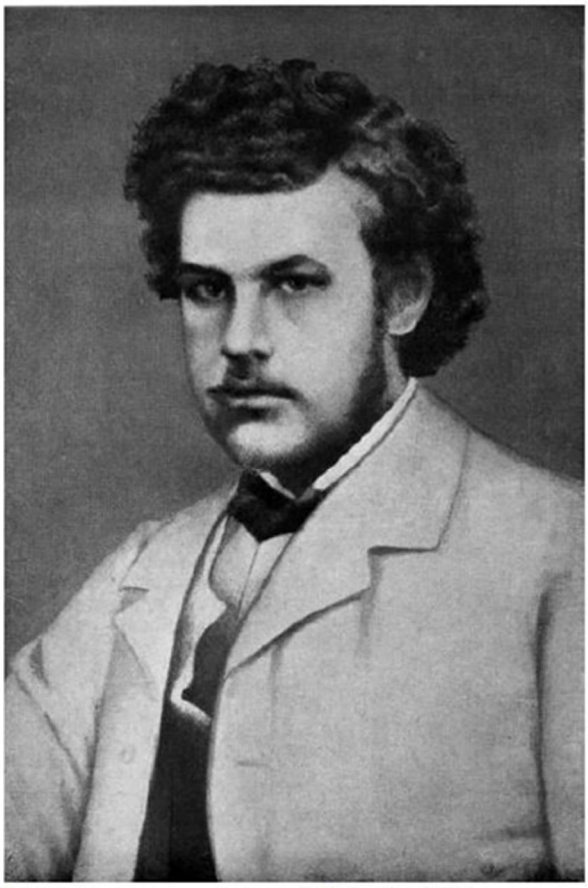


Fig. 8. V. Dokuchaev as a seminary student. Archive CSM (Ф. 2. Оп. 39. Д. 1. Л. 5).

Readers interested in the history of soil science and pedology especially will be interested in this anniversary issue at this site:
https://bulletin.esoil.ru/jour

Although most articles are in Russian, all have English abstracts and one article is fully in English:

Rusakova E.A., Timofeeva Yu.R., 2021. Vasily Dokuchaev (to the 175th anniversary). *Dokuchaev Soil Bulletin*, 2021, Special Issue, pp. 155-200.
https://bulletin.esoil.ru/jour/article/view/647

Our land 2021 – Tō tatou whenua 2021

On 15 April 2021 the Ministry for the Environment and Stats NZ released the latest environmental report Our land 2021 (https://environment.govt.nz/publications/our-land-2021/). This report is different from previous environmental reports as it focuses on a single theme 'Land-use change and intensification'. New data on land cover (LCDBv5), land fragmentation and soil health are presented.

Manaaki Whenua Landcare Research played an instrumental part in the development of this report. The aforementioned datasets were produced by MWLR (various teams led by David Pairman, Sam Carrick and Bryan Stevenson), and several MWLR land and soil scientists were involved in providing scientific and mātauranga Māori advice (Garth Harmsworth, Anne-Gaelle Ausseil), leading the science writing (Nina Koele), and reviewing drafts (John Drewry, Bryan Stevenson).

The report received good media coverage:

- https://thespinoff.co.nz/food/15-04-2021/new-report-warns-that-were-building-over-our-food-basket/

- https://www.rnz.co.nz/news/national/440519/an-eroded-environment-under-pressure-and-the-loss-of-productive-land-new-report-reveals
- https://www.rnz.co.nz/national/programmes/ninetonoon/audio/2018791822/food-growing-land-being-eaten-up-report
- https://www.nzherald.co.nz/nz/paradise-under-pressure-report-reveals-toll-of-intensive-dairying-urban-sprawl/SZR2EIPKXF6AOBJNV4EMEBJ5UU/
- https://www.stuff.co.nz/environment/climate-news/124836211/best-fruit-and-veggrowing-land-still-being-munched-by-housing

Sustainable Vegetable Systems – Short programme summary for Soil News February 2021

By Alex Michel

The Sustainable Vegetable Systems (SVS) programme is an industry-led project funded by the Ministry for Primary Industries, Potatoes New Zealand and the Vegetable Research and Innovation Board, aiming to provide New Zealand vegetable growers with support tools to help manage nitrogen (N) and reduce nitrate leaching. The New Zealand Institute for Plant and Food Research Limited (PFR) is the science provider. A review of the literature on nitrate leaching associated with vegetable crops, with a focus on New Zealand production systems, was conducted. The review revealed that, for most vegetable crops, there was either a lack of data or the existing data were becoming outdated because of changes in practices. The SVS programme is organised into four work streams.

The first work stream consists of experimental work, designed to understand leaching and enable robust modelling, and includes four different vegetable rotations across two locations. This work will be carried out at the PFR sites in Hawke's Bay and Lincoln. The rotations consist of a mix of vegetable crops and break/cover crops to fit in with the different crop requirements. Treatments consist of four different rates of N fertiliser, from a nil control to twice what would be considered good practice, and two different irrigation regimes, one with adequate water supply to avoid drainage unless there is a high rainfall event, and one with over-supply and inducing drainage on occasions or in case of rainfall. The aim of the treatments is to create a range of nitrate leaching scenarios. Plant, soil and leachate samples will be collected throughout the experiments.

The data produced from the trial work will feed into modelling work to improve existing tools and potentially develop new tools to help vegetable growers manage N inputs.

The second work stream is the collection of on-farm data to inform modelling. These data will mostly mirror data collected in the first work stream, and will mainly be used

for validation purposes. The third work stream involves developing models, tools or resources to help end users, training industry people to use models, and improving confidence in models. The focus of the fourth work stream is an extension of the key findings of the programme to vegetable growers.

Photo 1. Aerial view of one of the rotations at Lincoln, which consists of potato, wheat (crop pictured), broccoli, onion and ryegrass seed.

Photo 2. Aerial view of the other rotation at Lincoln, which consists of pak choi (crop pictured), oat, potato and carrot.

Call for Papers

Call for Papers: Special Issue "In Recognition of Mike Hedley: Fate of Fertiliser in Soil and Mobilisation of Recalcitrant Nutrients"

This special issue will welcome reviews, research papers, and modelling studies that examine the Fate of Fertiliser in Soil and propose new ideas for Mobilisation of Recalcitrant Nutrients.
Guest Editors: Richard McDowell and Lucy Burkitt.
Submissions close on April 30, 2022.

Nutrient Cycling in Agroecosystems is seeking submissions for a Special Issue on Fate of Fertiliser in Soil and Mobilisation of Recalcitrant Nutrients. All manuscripts will be peer-reviewed by 2-3 independent reviewers and handled by the Guest Editors, in collaboration with the Journal's Editors-in-Chief. Special issue papers accepted for publication in the Special Issue will be available online soon after acceptance, and before inclusion in the Special Issue.

Increased nutrient use efficiency and reduction of nutrient losses are needed to keep our food systems within environmental limits. In regions with application of nutrients in excess of plant requirements, long-term fertiliser use has led to a build-up of

recalcitrant (also called legacy) nutrients. A reduction of fertiliser use by at least 20% by 2030 and an increased use of bio-based fertilisers are central in the Farm to Fork strategy that is part of the European Green Deal. Both require an improved understanding of the chemical forms and location of different fertilisers in the soil, and the development of strategies to mobilise recalcitrant nutrients, such as phosphorus, potassium, selenium, and molybdenum. The sequential fractionation method[1,2] developed by Mike Hedley and others in the 1980s has contributed substantially to important insights into the plant availability of different forms of phosphorus. More recent approaches such as spectroscopic and isotope methods have allowed us to deepen our understanding and extend our knowledge of phosphorus and other nutrients. Therefore, this special issue will welcome reviews, research papers, and modelling studies that examine the Fate of Fertiliser in Soil and propose new ideas for Mobilising Recalcitrant Nutrients.

Papers should focus on (i) mechanisms that increase the mobilisation of recalcitrant nutrients, (ii) measurements of the size and nature of recalcitrant nutrient pools that could potentially be mobilised by different technologies, or (iii) improved conceptual models of residual nutrient cycling in soils in order to improve the fertiliser use efficiency and contribute to circular food systems. We encourage authors to consider emerging interdisciplinary developments that might be used to promote the mobilisation of recalcitrant nutrients. We are particularly interested in scalable projects that maximise the mobilisation of recalcitrant nutrients while ensuring optimal plant growth and protect planetary boundaries of nutrient flows.

For more details see: https://www.springer.com/journal/10705/updates/19085624

News from the Regions

Waikato/Bay of Plenty

AgResearch Ruakura

The New Zealand Grasslands Association ran a 2-day symposium on 'Resilient Pastures' at Karapiro in May. The event brought together researchers and practitioners in a forum designed to create research insights followed by a discussion of the issues. Dave Houlbrooke (along with co-authors John Drewry, Wei Hu, Seth Laurenson and Sam Carrick) presented a paper entitled Soil Structure - its importance for resilient pastures. The talk was part of a series of soil science papers designed to cover Soil biology (Shengjing Shi), Soil N (Mark Shepherd) and Soil C (Louis Schipper). Many farmers commented afterwards that it was great to see soil science back on the agenda as part of the solution for their pasture-based challenges. Mark observed was that it was nice to see soils front and centre at a pasture resilience conference, but recognised that you can't think about the soil in isolation from the rest of the plant-animal-environment system.

A four-year trial assessing N leaching under dairying on two farms, on either free-draining or podzolised pumice soils, in the Lake Rotorua catchment (both on sites of >2000 mm rainfall/year) has been completed and final results were presented to farmers and Regional Council staff by Stewart Ledgard. This work was supported by

BOPRC, DairyNZ, Overseer Ltd., and MPI. It showed somewhat lower leaching from the podzolised pumice soil compared with OVERSEER predictions and was related to the soil category used, and the apparent importance of a perched water-table over a relatively impervious ignimbrite layer. Research on N leaching is continuing at the free-draining pumice farm, with split areas evaluating Spikey.
Stewart Ledgard recently had 3 months off and has returned to AgResearch revitalised (!) and is working 4 days per week.

Photo: Graham Smith describing his dairy farm system, planted in Paulownia trees.

The first year of a 1 Billion Trees-funded project on trees in the pastoral project is nearly complete. The aim of this collaboration between AgResearch (Gina Lucci; Stuart Lindsey and Gosia Zobel), SCION (Simeon Smaill and Reina Tamepo), farmers and landowners, and the NZ Landcare Trust, is to develop a decision support module that will provide users with an understanding of the environmental and cultural benefits trees have in pastoral landscapes. From March to April 2021 three hui were held with the intention of sharing knowledge among group participants, observing examples of different plantings on pastoral farms, and discussing the creation of the decision support tool. The group visited one dairy farm and two sheep and beef farms, and inspected a wide range of trees integrated into these farm systems. From these three hui, the group has established what success looks like; developed an understanding of the scope of the tool; identified priorities for inclusion in the tool; and ascertained how this tool will be used in the decision-making process.

Lincoln Agritech

Critical Pathways Programme

The MBIE-funded Critical Pathways Programme (CPP) aims to unravel the different pathways of contaminant transfer at the sub-catchment scale, so the team have been busy preparing sites for continuous flow and nitrate monitoring (Figure 1, Figure 2), and installing pressure sensors in selected streams to monitor water levels over time.

Figure 1: A Geolux Radar and NICO nitrate sensor have been installed on the Wharepapa stream sub-catchment in our Waiotapu study catchment to provide continuous flow and nitrate data.

Figure 2: A Geolux Radar installed on the Waiotapu Stream, just south of the Homestead Road bridge at the catchment outlet will provide continuous flow data for the whole catchment. A NICO sensor is also installed at this site for continuous nitrate recordings.

By the end of this quarter, LAL will have five NICO sensors installed across our two study catchments. We have found that despite being installed with a wiper to clear biofilms, in some locations they were prone to inorganic fouling, likely caused by high concentrations of iron and manganese in the water. After a couple of months in the stream, the sensor was covered in black/brown precipitate which does not rub

off. In consultation with HyQuest Solutions (the distributor for TriOS sensors in NZ) we have found that a quick dip in an oxalic acid solution cleans them up beautifully (Figure 3).

Figure 3: TriOS NICO sensor before and after cleaning with oxalic acid.

HydroMetrics nitrate water testing events

HydroMetrics is a division of Lincoln Agritech Ltd that manufactures real-time nitrate groundwater monitoring sensors for land owners and businesses.
To demonstrate the effectiveness of the sensors, HydroMetrics ran a two hour public event on campus at Lincoln University and set up a nitrate water testing station. This event attracted many Selwyn locals who wished to test their rural well supply.

We collated all the test results (Figure 4) and here are our conclusions:
59 water samples were measured for nitrate from local drinking water wells. Of those samples, 44 people kindly agreed to allow us to share the results anonymously so others in the region could understand the potential issues.

The team recorded two samples that exceeded the World Health Organisation (WHO) Maximum Allowable Value (MAV) (orange line on the graph); however you can see there was a large number of wells were recording more than 50% of MAV (thick grey line on the graph).

11.3 mg/L Nitrate Nitrogen (NO3-N) limit is recommended by the WHO, which is currently adopted by the New Zealand Government.

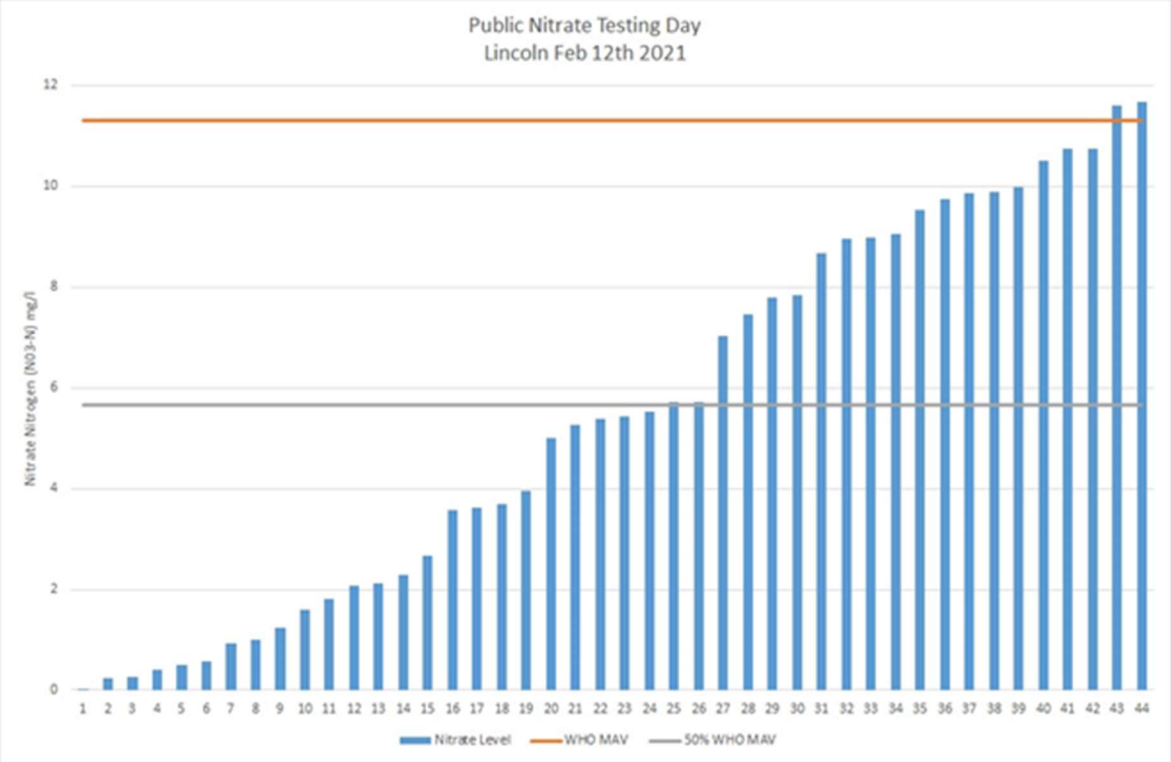


Figure 4: Nitrate concentration (mg N/L) measured in water samples at the Lincoln University open day.

The HydroMetrics nitrate water testing station proved to be so popular that the team decided to repeat the event at the South Island Agricultural Field Days in Kirwee. For a gold coin donation, members of the public were able to get their water tested. The monies raised from the event was then donated to Farmstrong charity to support mental health of rural sector.
For more information visit, www.hydrometrics.co.nz.

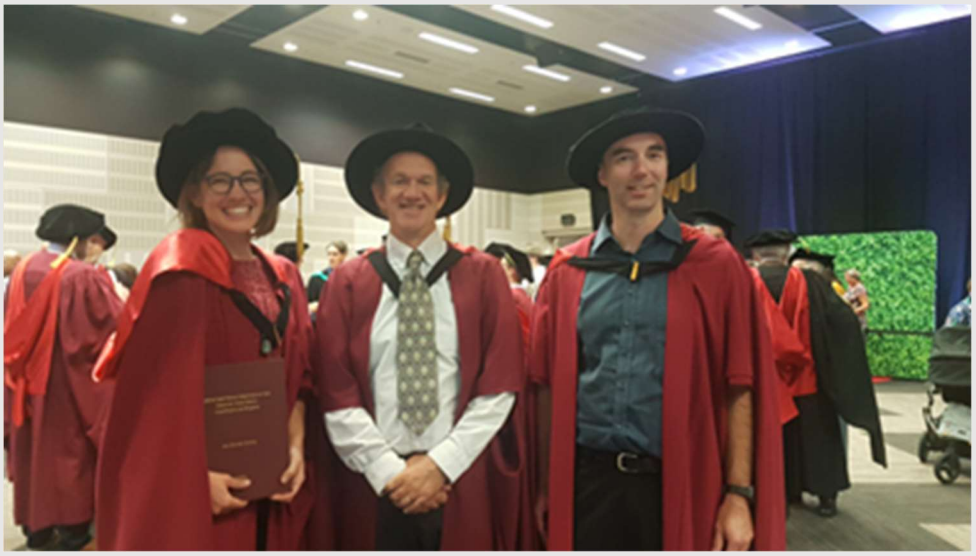
Recent Publications:

Barkle, G., Stenger, R., Moorhead, B., Clague, J. (2021) The importance of the hydrological pathways in exporting nitrogen from grazed artificially drained land. *Journal of Hydrology* 597 126218.
https://doi.org/10.1016/j.jhydrol.2021.126218
Gosses, M., Wöhling, T. (2021) Robust data worth analysis with surrogate models. *Groundwater.* https://doi.org/10.1111/gwat.13098

University of Waikato

Congratulations to **Aaron Wall** and **Anne Wecking** (supervised by Louis Schipper) who were awarded their PhD in the recent graduation ceremony. Aaron examined the carbon balance of dairy farms including the role of maize production and use. Anne measured nitrous oxide emissions at paddock scale and compared these to emission factors and chamber approaches and lastly demonstrated that a quantum cascade laser used for eddy covariance measurements could also be used for rapid measurements of nitrous oxide from chambers while still in the field. Another of

Louis' students **Jasmine Robinson** successfully defended her PhD on the temperature response of different carbon pools in soil.



Dr Anne Wecking, Louis Schipper and Dr Aaron Wall at graduation. Photo supplied by Louis Schipper

Louis Schipper, Dr Jasmine Robinson, and Vic Arcus after lunch to celebrate passing Jasmine's oral exam. Photo supplied by Louis Schipper

Louis was also involved in a paper https://advances.sciencemag.org/content/7/3/eaay1052 co-authored with colleagues from Northern Arizona University that used a data-driven model that predicted there would be a near halving of the land carbon sink strength by as early as 2040. This paper attracted local and international media attention and was featured on a youtube video created by Scishow and has been viewed >160,000 times. https://www.youtube.com/watch?v=1NBQZkySDY0

Despite Covid's major impacts on teaching last year, Waikato University has restored face-to-face teaching since March this year. The graduate soils paper run by Tanya O'Neill and David Lowe was well supported with 11 students enrolling in

2021. One of the best parts of the paper is their mapping exercise on AgResearch's Tokanui farm just south of Te Awamutu. The photo shows this year's class in the mapping area in mid-March.

Class of 2021 at Tokanui Farm. Photo: D.J. Lowe

Meanwhile, David continues to be heavily involved with his "Tephra Seismites" project funded by MBIE and Marsden (see https://tephra-seismites.com/). The team is nearly complete – David is just awaiting a second PhD student to come from Moscow whenever she can get across half the world and through the border to join us. Most recently the team went to a lake in the northern part of Hamilton Basin to sample near-surface tephra layers for geotechnical lab work and CT scanning, as shown below.

Tephra seismites team in the field: from left Danche Chaneva, Tori Gibbons (at back), Dr Vicki Moon, Dr Tehnuka Ilanko, Dr Max Kluger, and Richard Melchert. They weren't quite so smiley after a messy day sampling organic lake sediment. Photo: D.J. Lowe

Tuhua tephra (7.6 cal ka) (top layer) and Mamaku tephra (8.0 cal ka) (bottom layer) exposed in shallow lake sediments. Pen (upper left) provides scale. Tuhua was erupted from Mayor Island (Tuhua Volcanic Centre) and Mamaku from the Okataina Volcanic Centre. Photo: D.J. Lowe

View of CT images of the pair of tephras at Hamilton Radiology, where Nic Ross scanned a 'monolith' containing both tephra layers. Different orientations and images of the tephras can be seen on the computer screen. Photo: D.J. Lowe

Dave Campbell (Waikato University) and former Waikato graduates **Justin Wyatt** (Waikato Regional Council) and **Jack Pronger** (Manaaki Whenua Landcare Research) were keynote speakers at the NZ Institute of Primary Industry Management: *Peat Perspectives in the Waikato* workshop on 31st of March. The meeting was attended by a diverse bunch of around 40 peat enthusiasts, scientists, managers, and farmers. The team presented on topics including subsidence and greenhouse gas emissions from drained peat soils, and mitigation options to reduce shrinkage and carbon loss from peat soils.

From left to right, Justin Wyatt (WRC), Dave Campbell (UW) and Jack Pronger (MWLR) at the Peat Perspectives in the Waikato workshop. Photo: D.J. Lowe

Manawatu

Manaaki Whenua – Landcare Research

We celebrated Garth Harmsworth's appointment as a Ngā Ahurei a Te Apārangi Fellow of the Royal Society of New Zealand, and he is elected to the Academy of the Royal Society Te Apārangi. Being made a Fellow is an honour that recognises distinction in research, scholarship or the advancement of knowledge at the highest international standards.

This is a well-deserved honour for Garth and his numerous years integrating Māori values for the natural environment into resource management decision-making, developing culturally appropriate indicators that reflect Māori land and freshwater values, and advancing collaborative and kaupapa Māori research.

A summary of Garth's outstanding contribution is presented below, copied from the Royal Society of New Zealand. https://www.royalsociety.org.nz/news/researchers-and-scholars-elected-to-academy/#Garth

With 37 years of research leadership, Garth Harmsworth (Te Arawa, Ngāti Tūwharetoa, Ngāti Raukawa) is renowned for his work building Māori research capability nationally, and advancing mātauranga-based kaupapa Māori and collaborative research practice. Garth's research has directly unlocked the potential of Māori land, ensuring culturally relevant approaches and information-systems to

support legislation, policy and statistics, and improve land management across Aotearoa. He engages with Māori landowners, organisations, iwi/hapū and government to bridge Western science and mātauranga Māori, while always ensuring the benefits of a te ao Māori worldview are captured. Throughout his research career, he has integrated Māori values for the natural environment into resource management decision-making, developed culturally appropriate indicators that reflect Māori land and freshwater values, and has advanced collaborative and kaupapa Māori research. His knowledge and understanding of catchment management from the tangata whenua has been ground-breaking in establishing sustainable development approaches. He has brought a te ao Māori perspective to a conventionally 'biophysical' science discipline, which now serves as a best practice guide for future land use within Aoteaora and across the globe.

Photo: A morning tea at MWLR to celebrate Garth Harmsworth's appointment as a Ngā Ahurei a Te Apārangi Fellow of the Royal Society of New Zealand

Our pedologist Sharn Hainsworth left Manaaki Whenua at the end of March. Sharn joined Manaaki Whenua – Landcare Research in 2012. He started out with Topo-climate South in Southland, soil mapping and improving soil information for farmers and stakeholders with Sam Carrick. He undertook soil mapping of the Hawke's Bay region and made a significant contribution to mapping the region for S-map. He contributed interpretation of soil map information for use by a range of stakeholders, soil mapping for S-map in the Wellington region and other regions, and informing and keeping the linkage of soil mapping with geomorphology. We thank Sharn for his many contributions to soil pedology, soil mapping and Manaaki Whenua.

We welcomed Flo van Noppen into a laboratory role in our environmental chemistry and soil physics laboratories. We also welcomed Genevieve Smith into a laboratory role.

Massey University

Ainul Faizah Mahmud has successfully completed her PhD studies at Massey University working on the project "An investigation on the stability of biochar-C in soils and its potential use to mitigate non-CO_2 greenhouse gases using near-infrared (NIR) spectroscopy", under the supervision of **Marta Camps-Arbestain** and **Mike Hedley** (Soil Science, Massey University). The potential for biochar application to increase soil organic carbon (SOC) stocks and its potential agronomic and additional environmental benefits, such as reducing soil nitrous oxide (N_2O) emission, are determined by its stability in the soil, which is dependent on its intrinsic properties and soil conditions. Ainul's research also focused on practical and reliable techniques that can be used to verify the reported maximum pyrolysis temperature, regardless of the type of feedstock used and predict the likely stability of the biochar. Her thesis evaluated (i) the use of near-infrared (NIR) spectroscopy technique for predicting the maximum pyrolysis temperature of biochar; (ii) the effect of biochar application, with special attention to biochar particle size and depth of placement, on N_2O soil emission and SOC stocks; and (iii) the integrated use of NIR spectroscopy for SOC measurement.

Photo: Detail (experimental set up) of a controlled glasshouse study conducted by Ainul to investigate the effect of biochar particle size and the impact of soil inversion (through simulated mouldboard ploughing) on N_2O emissions from soils to which cattle urine was applied.

The information obtained in this thesis contributes to tailor the use of biochar by understanding the effects of depth of placement and particle size on N_2O emission from biochar-amended soil, the mineralization of native SOC, and the changes in SOC stocks over time, particularly in the pastoral soils of New Zealand. Also, based on this study, the use of NIR spectroscopy technique may potentially be integrated as part of the methodology for SOC estimation.

FLRC workshop 2022

After a year break in 2021, the FLRC is putting into action planning for the 34th Annual FLRC workshop to be held on the Massey University Manawatu campus between 9-11th February 2022.

Watch out for news on this event over the coming months. We look forward to welcoming everyone back to a face-to-face FLRC event in 2022.

Farm Environment Planning courses running

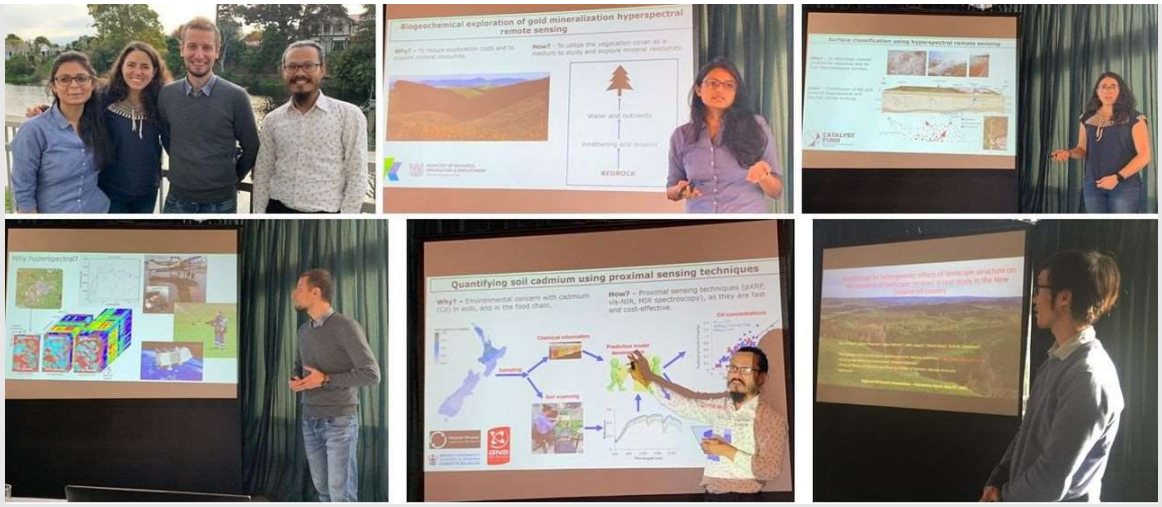
Massey University launched its first Advanced Farm Environment Planning course in March, with students attending a week of farm visits in the Manawatu before developing three freshwater farm plans for an arable, beef and sheep and dairy farm. A second Advanced course will be offered in the second half of 2021, along with additional Intermediate Farm Environment Planning courses. More information can be found at https://www.massey.ac.nz/~flrc/courses.html or by contacting Fiona Bardell F.M.Bardell@massey.ac.nz.

Mike Bretherton (Massey University) hands on with students, visiting farms during the Advanced Farm Environment Planning course.
Photo credit: Massey Communications.

Regional GIS Forum in the Manawatu

On May 7, a **Regional GIS Forum** was held at The Chalet, Hokowhitu, Palmerston North, organised by Horizons Regional Council. Together with Prof. **Diane Pearson**, Associate Prof. **Ranvir Singh** and Senior Lecturer **Gabor Kereszturi**, Massey PhD students **Suha Sanwar**, **Cecilia Rodriguez Gomez**, **Rupsa Chakraborty**, **Duy Tran** and **Gautam Shrestha** participated in the forum, presenting different bits of their research.

Along with Gabor, Cecilia, Rupsa and Gautam jointly presented their research findings in the talk entitled "*Applications of hyperspectral remote sensing for an improved land mapping and characterisation*". Duy presented his findings entitled "*Quantifying the heterogeneity effects of landscape structure on the provision of landscape services: a case study in the New Zealand hill country*".



Clockwise from top left: Rupsa, Cecilia, Gabor and Gautam at The Chalet; Rupsa, Cecilia, Gabor, Gautam and Duy in action, presenting their research. Photos courtesy of Gautam Shrestha.

Participants recall a good day, big in terms of numbers and full with a very mixed content. The forum had 100 registered for the day and fed 90 people from 36+ organisations. A wide audience was represented, including organisations as Manaaki Whenua, regional and district councils, ALGIM, Eagle technology and others.

Canterbury

Lincoln University

Research Milestone

Lincoln University Professor of Biogeochemistry, Leo Condron, recently passed a significant research milestone by publishing his 250th peer-reviewed journal paper. He published his first paper in 1985, and his current Web of Science publication profile lists 10,000 citations for journal papers (average 40 citations per publication, 275 per annum), with a H-Index of 54 (i.e. 54 publications have been cited at least 54 times). Google Scholar lists 360 publications for Professor Condron, which have received 18,500 citations, with an H-Index of 72.

Prof Condron has published papers in over 50 journals, including Plant and Soil (21), Soil Biology and Biochemistry (21), Geoderma (18), Biology and Fertility of Soils (17), the New Zealand Journal of Agricultural Research (14), and the Journal of Environmental Quality (12). Prof Condron has also contributed to publications in FEMS Microbiology Ecology (4), Biogeochemistry (4), Global Change Biology (3), and Science (1). He has also authored/co-authored 15 book chapters, and contributed to two major reports on the status of New Zealand soils for the United Nations (UNESCO (2002), FAO (2015)).

Prof Condron is currently Associate Editor/Section Editor of 6 international journals, namely the European Journal of Soil Science, Frontiers in Soil Science (Soil Biogeochemistry and Nutrient Cycling), Geoderma Regional, the Journal of Soil Science and Plant Nutrition, Soil Research, and Soil Use and Management.
Prof Condron is a Fellow of the British Society of Soil Science and the New Zealand Society of Soil Science, and has been elected to two 4-year terms as Chair/Co-Vice Chair of different divisions of the International Union of Soil Sciences (2006-10, 2018-22). He was awarded two OECD Co-operative Research Programme Fellowships in 2002 (Institute of Grassland and Environmental Research, UK) and 2014 (Universidad de la Frontera, Chile).

Prof Condron (left) soil sampling on the Haast chronosequence in February 2020 with Prof Kari Dunfield (University of Guelph, Canada) and Dr Alan Richardson (Chief Research Scientist, CSIRO, Australia).

Professor Condron's research has focused on investigating the biogeochemistry of organic carbon and major nutrients in natural and managed ecosystems, with an emphasis on the nature, dynamics, and bioavailability of organic and mineral forms of nutrients in the soil-plant system in relation to soil management and land use. Project areas include organic matter and nutrient dynamics in grassland and forest soils, biochar impacts on soil nutrient dynamics, soil chronosequence biogeochemistry, rhizosphere processes and nutrient acquisition, relationships between soil microbial diversity and function, and the nature, and the bioavailability and mobility of phosphorus in terrestrial and aquatic environments. His sustained contribution to advancing research on the biogeochemistry of phosphorus in soil-plant systems was recognised by the award of a Doctor of Science degree by the University of Canterbury in 2016. Prof Condron has developed and maintained an extensive network of research collaborations within New Zealand and across the globe, including Australia, Brazil, Canada, Chile, China, Germany, Panama, Sweden, Switzerland, UK, and USA, and to date he has supervised over 100 postgraduate students from 21 countries, together with 11 postdoctoral fellows.

Manaaki Whenua – Landcare Research

Critical Pathways Programme (CPP) - An update

As already reported in the last newsletter, work in the MBIE-funded Critical Pathways Programme (CPP) led by Lincoln Agritech is in full swing. The programme aims at better understanding the different pathways of contaminant transfer at the sub-catchment scale. Soils are a vital component of these transport pathways, be it within the vadose zone or as part of the uppermost groundwater zone. To characterise the hydraulic and chemical properties of soils in CPP's study catchments, Scientists from Manaaki-Whenua – Landcare Research (Andre Eger, Jonno Rau, Malcolm McLeod, Scott Fraser and Nadia Laubscher) dug, sampled, and described 25 soil profiles across hillslope transects in the Waiotapu and Piako catchments in the Waikato. Mainly formed from tephric parent material (pumice, volcanic ash) or its fluvial and colluvial derivatives, the soils comprised the full range of drainage classes.

Laboratory analyses are currently underway to determine water holding capacity and conductivity, and chemical properties indicative of weathering, soil carbon content and redox status to a depth of up to 1.50 m. The data will be initially used to improve current pedotransfer models of soil hydraulic properties, particularly those for Pumice Soils. In addition, the soil transects were aligned with groundwater wells and geophysical measurements. This allows the CPP to directly explore the link between the soil characteristics and the groundwater, and support the interpretation of the data from the spatially more extensive geophysical surveys.

Figure 1: Typical variability of a Pumice Soil. Abundant pumice fragments and cemented pumice sands made undisturbed sampling challenging (Photo: Malcolm McLeod).

Figure 2: Taking soil cores below the groundwater level with the help of a pump usually resulted in some serious work for the washing machine, but also yielded subsoil samples from depths that are usually not sampled (Photo: Malcolm McLeod).

Obituary

Robert Frith Allbrook (1928-2020)

David J. Lowe
School of Science/Te Aka Mātuatua, University of Waikato, Hamilton
(david.lowe@waikato.ac.nz)

Introduction: legacy

Dr Robert (Bob) Allbrook (10 November 1928-18 September 2020) was a lecturer in soil science at the University of Waikato in Hamilton from February 1975 until his retirement on 31 December, 1993, a tenure of service of nearly 20 years. Bob was appointed relatively early in the development of the Department of Earth Sciences, which had been founded in 1970 within the newly-formed School of Science. By 1975, Bob had considerable experience under his belt (see below). His main role was to help Prof Harry Gibbs with teaching responsibilities broadly in soil science. The aim in those days was to have at least two academics involved in teaching in each subdiscipline, including soil science, within the subject of Earth sciences, so that staff could have time to work on research and supervision and undertake sabbatical leave without compromising the all-important burgeoning teaching programme.

Bob was responsible for running the main soils lab, where he taught literally hundreds of students (a total of around 800 according to Balks, 1993) about soils and their physical, chemical, and mineralogical properties. He also supervised/co-supervised graduate students in their research, taking on masterate students (including Bill Cotching, Jimmy Seouw, Warwick McDonald, Chris McLay, Colin Gray, Kathryn Hughes, Richard Chapman, Mark Buckley, Zane Wealleans, Anwar Ghani, and Brian Warburton) and then a number of excellent PhD students (including Richard Chapman, Megan Balks, and Rob Lieffering), guiding them to satisfactory completion mainly in the field of soil physics.

Bob in the lab measuring soil grain size distributions using the pipette method (1980s). Photo: (probably) Rex Julian or Ross Clayton.

Bob was excellent in his capacity as a supervisor, being outwardly somewhat strict but actually very supportive throughout. His students have all gone on to good careers including a number attaining high level appointments both in New Zealand and overseas, just two examples being Dr Chris McLay (appointed to replace Bob in the Department of Earth Sciences from 1994-2002), who is now CEO of Waikato Regional Council, and Warwick McDonald who, until March 2020, was Research Director, Water Resource Management, CSIRO Land and Water, Canberra (Lowe and Balks, 2018).

Bob made a substantial contribution to both the university and to the discipline of soil science with his publications, teaching, and mentoring, which stand as part of his legacy.

Early life and career

Bob grew up in North London and went to school in the City. His school organised farm work during summer holidays to help farmers bring in the harvest as part of the

war effort. After leaving school, two years of compulsory military service in the British Army followed (1946-48). He attained the rank of sergeant. Bob injured his knee in an accident whilst disposing of ammunition and he later credited this unfortunate event, which hospitalised him, as saving him from being sent to serve in the Korean War that broke out mid-1950. Bob worked on a farm for a year or more after his military service because that was a minimum requirement for him to enrol in the Faculty of Agriculture at King's College in Newcastle (then a college of the University of Durham). He graduated with a BSc in agriculture in 1956 and BSc(Hons) in agricultural chemistry in 1957.

Soon after, in 1957, Bob was appointed by the UK Colonial Service to undertake soil survey-related work in Nigeria for the United Nations to identify soils suitable for cocoa (Balks, 1993). He left in May, 1958, and worked in Sierra Leone on a project to generate the Commission for Technical Co-operation in Africa (CCTA)/FAO 'Soil Map of Africa' 1: 5,000,000 (published in 1964) before returning to the UK in where he married Rosemary Brown in London in 1963. The couple then travelled to Jordan under the British Aid programme (1964-65) where Bob undertook soil, water, and leaf analyses on oranges in the Jordan Valley. High levels of Na and Cl ions in irrigation water had led to chlorosis (Allbrook, 1967). Rosemary reported during her eulogy at Bob's funeral (23 September 2020) that these were 'the best of times' and 'the worst of times', the latter referring to the sad death of their first child soon after birth.

Malaya (now Malaysia) was the next destination and Bob taught in the Faculty of Agriculture and Department of Geology at the University of Malaya in Kuala Lumpur for six years (1967-73) (Balks, 1993). He began working towards his PhD on the genesis and characteristics of soils derived from recent marine sediments in northwest Malaya, including soils used for rice production (Allbrook, 1977). (The PhD thesis was finalised in Hamilton in 1975 when Bob began at Waikato.) With the rapid progress of teaching in Bahasa Malaysia (the Malaysian language), expats were forced to leave the country. Bob and Rosemary, with daughters Georgina and Hilary, came to New Zealand in 1973, with Bob appointed as an agricultural officer in the Ministry of Agriculture in Palmerston North for two years (1973-75) (Allbrook and Stiefel, 1976).

University of Waikato (1975-1993)

As well as teaching, Bob worked on a wide range of topics whilst at Waikato including characterising the components and properties of volcanic soils in central North Island and Taranaki. His research encompassed some aspects of soil chemistry (e.g. Ghani and Allbrook 1986) but largely he mainly focussed on the field of soil physics, including studies on the special properties of allophane and allophane-rich soils (Allbrook, 1983, 1984, 1985; Allbrook and Radcliffe 1987) along with soil compaction, shrinkage, fractals, and other topics relating closely to land management, such as impacts of cultivation (Cotching et al., 1979; Allbrook, 1980,

1981, 1986, 1988, 1992, 1994; Balks and Allbrook, 1991; McLay et al., 1992; Gray and Allbrook, 2002).

Two interesting applications of Bob's work with students involved rugby and cricket: Richard Chapman's PhD involved subsoiling trials on the physical properties of soils at Rugby Park (now Waikato Stadium), Hamilton, in preparation for the internationals held there during the Rugby World Cup of 1987 (Chapman and Allbrook, 1987); and Zane Weallean's MSc thesis involved research on the 'playability' and management of cricket pitches.
Bob was also interested in the history of soil science in New Zealand (Allbrook, 1990, 1997).

Bob spent three periods away from Hamilton on sabbatical leave, one at Scottish Institute of Agricultural Engineering at Scottish Station, Bush estate, at Penicuik near Edinburgh, then in Oregon, USA, and finally a leave divided between Reading and Thailand where he was to help set up a soil science laboratory. Unfortunately, construction of the building to house the lab had barely begun when Bob arrived in Thailand and so that objective was unattainable. Nevertheless, he was kept busy helping students who were all taught in English.

Adventures in Northland
I was embarking on graduate study in 1975 when Bob arrived, and later as a lecturer I worked closely with him at times, including jointly taking our third-year soil science students to Northland each year for a three-day pedology field trip (which I continued running up until 2010). It seems somewhat ludicrous now, but on one such trip in March 1980, during the infamous 'carless days' from July 1979-May 1980, we had to take extra cans of petrol in our van and divert to a garage in Auckland to surreptitiously pick up more fuel to complete our journey. (Mind you, with COVID-19 and the year of 2020, carless days seem almost rational now.)

On another occasion our trip north coincided with the arrival of a tropical cyclone. All I can remember is torrential rain, so much so that we completely abandoned our trip (we could not even find our field sites, such were the conditions), and ended up in a pub somewhere remote in the winterless north to dry out.

Bob at the wheel during a Northland field trip when it barely stopped raining (15 March 1980). Photo: David Lowe

On these trips we used to stay at a church youth camp near Marsden Point and, because the camp was strictly alcohol-free, we used to ban the students from taking any alcohol (that we were aware of). On one memorable trip we had just arrived in the early evening. Bob and I were speaking to the camp manager, who always ensured the rules were followed to the letter. As we were chatting in the descending darkness, I noticed Bob was covertly clutching to his side a brown paper bag from which suddenly slipped a bottle of beer (one of three) with a crash, shattering on the concrete path. Rather awkward to say the least but the manager saved the day by saying, “Well, better spilt on the ground than consumed”, or words to that effect.

On another occasion Bob had forgotten to ask the local farmer for permission to examine a mid-Holocene Podzol Soil exposed in a small sand quarry on his farm near Marsden Point, and a rather irate farmer turned up and seemed on the point of ‘having a go’. Very entertaining for the students of course. Bob managed to rescue the situation and himself with some well chosen words, possibly falling back on his military training to see the situation resolved.

Bob attempting to explain to an angry farmer near Marsden Point why Podzol Soils on sand are so special (March 1982). Photo: David Lowe

I was appreciative of Bob's support in my teaching and research. I especially enjoyed Bob's company at conferences where, away from the university, he was genuinely himself and very companionable.

Other aspects

Bob had many hobbies including bell ringing and, as well as singing bass in choirs, he learnt to play the double bass while Hilary was learning the violin. In Oregon, he played double bass in a small orchestra wearing a suit picked up from an op shop. Later in Hamilton Bob played in the Lyric Players performing in small concerts in rest homes, for example. In the early 1980s we both played together in a concert of the Waikato Symphony Orchestra (I played 1st trumpet).

During his retirement years Bob worked as a volunteer for Trade Aid, delivered Meals-on-wheels, was active with the local Red Cross committee as well as Save The Children, and helped out with garden upkeep at St Peter's Cathedral. He was for a time on the board of VSA. Bob was also a member of the 60+ club and U3A. I gave a talk at the 60+ club some years after Bob had retired, and he was in charge of 'audio visuals' at that time, helping me out.

Unfortunately, Bob developed vascular dementia and spent the last two years of his life in care at Tamahere on the outskirts of Hamilton.

Bob remained a true Englishman for his entire life, and a staunch Labour Party supporter. The singing of 'The Red Flag' at the conclusion of his funeral – possibly

the first time it had been heard in St Peter's Cathedral – seemed a fitting end to commemorate a very interesting and well-lived life.

Bob is survived by Rosemary, Hilary and partner Robin, Georgina and partner Douglas, and grandson Nicholas.

Acknowledgements
I am most appreciative of Rosemary Allbrook's help in compiling this obituary. I also thank Thomas (Tom) Batey, a close friend of Bob's since his early university days in Newcastle (and his best man), for his kind and helpful comments.

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News from European Soil Data Centre

Soil Organic Matter (SOM) fractions

Soil carbon sequestration is seen as an effective means to draw down atmospheric CO_2, but at the same time warming may accelerate the loss of extant soil carbon. By separating soil carbon into particulate and mineral-associated organic matter (POM and MAOM, respectively) aids in the understanding of its vulnerability to climate change and identification of carbon sequestration strategies. Arable and coniferous forest soils contain the largest and most vulnerable carbon stocks when cumulated at the European scale. In a recent publication in Nature Geoscience, we show a lower carbon loss from mineral topsoils with climate change (2.5 ± 1.2 PgC by 2080) than -previous estimates. Therefore, we urge the implementation of coniferous forest management practices that increase plant inputs to soils to offset POM losses and the adoption of best manage-ment practices to avert the loss in arable soils. Data are available in ESDAC
https://esdac.jrc.ec.europa.eu/content/soil-organic-matter-som-fractions

European Joint Programme EJP–Open calls

First external call is now open with a deadline **7.9.2021**. The objective of this call is to foster holistic ag-ricultural (forestry soils are not excluded) soil management practices which will assist in making a shift to diversify farming to include a variety of sustainable and environmental practices. Three topics addressed: a) SOC

sequestration b) soil biodiversity c) Improve sustainability, resilience, health and productivity of soils. In addition an call is open for Visiting Scientists support: Targeting partnerships and network within the EJP SOIL consortium to advance scientific joint work on climate-smart agricultural soils (**deadline: 31.5.21**)

EUROSOIL 2021 **(virtual congress 23-27 August 2021)**

The objective of Eurosoil 2021 is to bring together, in a safe online space, leading research scientists working on soil related topics and stakeholders dealing with issues of public concern, such as soil deg-radation and consequences of climatic changes. The important bridging role of soil practitioners to translate scientific knowledge into practice will be emphasised during the virtual edition of Eurosoil 2021. Early bird registration deadline: **26.5.2021**

https://eurosoil-congress.com/

SoilCare Final conference

The SoilCare project will be holding its final conference on **June 24th 10.30-15.00** (CET) with the aim of disseminating the findings of this EU-funded project and inciting discussion surrounding with results and policy recommendations.
Registration: https://www.crowdcast.io/e/soilcare

Abstracts

A systematic evaluation of multisensor data and multivariate prediction methods for digitally mapping exchangeable cations: A case study in Australian sugarcane field

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The acidic soil conditions in Australian sugarcane fields limit soil's capability to provide exchangeable (exch.) calcium (Ca) and magnesium (Mg). To replenish nutrient loss, the Six-Easy-Steps nutrient management guidelines were introduced to improve soil condition. However, laboratory analysis is required, and this is onerous. To value-add to soil data, digital soil maps (DSM) were developed by using two sources of digital data in three modelling approaches of geostatistical, statistical and hybrid. The effectiveness of digital data, either individually or combined, and varying number of calibration samples (n=10–120) was tested for obtaining moderate agreement (i.e. Lin's=0.65–0.80). The influence of varying number of calibration samples, was determined by calculating nugget to sill ratio (NSR) and used with ordinary kriging (OK) to make predictions. Moreover, four statistical approaches including one linear (i.e., multiple linear regression [MLR] and three nonlinear (i.e., Cubist, support vector machine [SVM], and random forest

[RF]) were compared. Hybrid models were generated by adding regression residuals (RR) to the statistical models. In addition, we compare the final DSM's by calculating the mean square prediction error (MSPE) and determining whether a traditional soil map, was as accurate. Results showed that while n = 50 could compute a moderate variogram (i.e. NSR = 25–75%), n ≥ 90 were required for stable results. Considering all data (i.e. n = 120), OK predicted Ca (0.69) and Mg (0.75) with agreement comparable to that of RF (0.64) and SVM (0.79). Overall, hybrid models of regression kriging (RK) and CubistRR (Cubist after addition of RR) had had largest agreement for predicting Ca (0.76) and Mg (0.81).
This was also reflected in minimum number of calibration samples whereby geostatistical and statistical models needed n ≥ 80 while hybrid models could still achieve moderate agreement with as low as n ≥ 20. The MSPE showed that irrespective of DSM approach, the traditional soil map was not as accurate for predicting either Ca (2.64) and Mg (0.26). The results show, that while the soil condition in the study fields was beyond the range of the Six-Easy-Seps nutrient management guidelines, the potential of DSM to improve soil capability was Demonstrated.

Geoderma Regional 25, (2021), e00400.
https://doi.org/10.1016/j.geodrs.2021.e00400

Cumulative effects of fragmentation and development on highly productive land in New Zealand.

Land fragmentation is a growing issue in New Zealand, however, no consistent or regular national monitoring has been established. A methodology for assessing land fragmentation was applied nationally for the first time, revealing that the greatest proportion of fragmentation occurred on land used for diffuse rural residence (>0.40 to ≤2.0 ha) and small parcels (>2.0 to ≤8.0 ha) with a 128% and 73% increase, respectively, between 2002 and 2019. In New Zealand, the most highly productive land (Land Use Capability (LUC) class 1, 2 and 3) is most impacted by continued fragmentation with 38%, 28% and 17% of baseline area, respectively, occupied by medium sized parcels or smaller (≤40.0 ha) with a dwelling in 2019. Impacts were greatest for Auckland with 40%, 44% and 25% of the region's LUC 1, 2 and 3 land, respectively, occupied by small sized parcels or smaller with a dwelling, increasing to 64%, 67% and 47%, respectively, when including parcels ≤ 40.0 ha. Protection of LUC class 1 and 2 land, particularly, requires national attention. This metric provides an opportunity to evaluate land fragmentation and development over time that could serve both the assessment of policy performance and environmental reporting at national and regional levels.

Curran-Cournane F, Carrick S, Barnes MG, Ausseil A-G, Drewry JJ, Bain IA, Golubiewski NE, Jones HS, Barringer J, Morell L 2021. Cumulative effects of fragmentation and development on highly productive land in New Zealand. New Zealand Journal of Agricultural Research (On-line early, open access): 1-24.
https://doi.org/10.1080/00288233.2021.1914688

Long-term monitoring of soil quality and trace elements to evaluate land use effects and temporal change in the Wellington region, New Zealand.

Soil quality monitoring is used to assess the soil's ability to maintain agricultural productivity, ecological, and environmental quality. Very few soil quality monitoring studies have reported on multiple samplings over the long-term. Several regional authorities in New Zealand have monitored soil quality since the late 1990s. In the Wellington region, dairy, mixed cropping, market garden, drystock (sheep/beef), horticulture, exotic forestry and indigenous land use systems, and four soil orders have been monitored over 19 years, with up to five repeat samplings per site. This study reports on key soil quality indicators and Cu, Zn, and Cd concentrations. For the most recent sampling per land use, all land use system sites, except drystock, had Zn concentrations below recommended ecological toxicity guidelines. Dairy land use had 21%, and 36% of sites within recommended soil quality target ranges, for Olsen P, and macroporosity, respectively. Compared with indigenous land, across all samplings, Cu concentrations were elevated in horticultural and market gardens sites, while several land uses had lower total nitrogen and higher Olsen P concentrations. Across all samplings, significant increases over time were observed in Zn for dairy, total nitrogen for drystock, and Olsen P for mixed cropping. Significant decreases over time were observed for Cu in forestry, Cd for indigenous and forestry, and bulk density for drystock. No changes over time were detected for macroporosity, anaerobically mineralised nitrogen, or organic carbon. This study shows the programme and our analysis of multiple samplings are valuable for detecting significant trends as an early warning, e.g. Zn and Olsen P changes. The study provides evidence for recommending additional sites for several land uses and increased sampling frequency to ensure future robust statistical analysis. This study included only sites where land use systems did not change, providing a robust basis for detecting change over time, for informing policy, resource and environmental decision-making.

Drewry JJ, Cavanagh JE, McNeill SJ, Stevenson BA, Gordon DA, Taylor MD. 2021. Long-term monitoring of soil quality and trace elements to evaluate land use effects and temporal change in the Wellington region, New Zealand. Geoderma Regional 25: e00383. https://doi.org/10.1016/j.geodrs.2021.e00383

Compaction induced soil structural degradation affects productivity and environmental outcomes: a review and New Zealand case study

Agricultural intensification has enhanced productivity, but has also negatively affected soil structure and environmental outcomes. Agriculture is among New Zealand (NZ)'s largest industries. Like other countries, significant land use intensification over the last 20–30 years has occurred in NZ, resulting in undesirable side-effect of soil structural degradation (SSD) (e.g., soil compaction, aggregate fragmentation). Using NZ as a case study, we reviewed and, where

possible, quantified the extent of SSD in NZ and its impacts and implications on production, contaminant losses via drainage and runoff, and N2O emissions. Knowledge gaps were identified that will help guide future research both in NZ and internationally. Our review revealed that SSD is common in many regions and under different land uses in NZ. At the national scale, 44% of sites monitored between 2014 and 2017 were below the national target for macroporosity (pore diameter > 30 μm). The occurrence of SSD was greater under more intensive land uses such as dairying and continuous cropping. Soil structural degradation from compaction is typically associated with reduced pasture and crop production. In NZ, pasture production was estimated to decrease by an average of 2.5% for every 1.0% (0.01 cm^3 cm^{-3}) decrease in macroporosity (0–10 cm soil). Compaction from livestock treading and wheel traffic has been shown to increase N2O emissions by 51–814% and 19–1300%, respectively, with no significant evidence that this increase is related to N loading. Effects of compaction on contaminant losses via runoff and drainage, and in particular via preferential flow, are less well researched and findings were less consistent and dependent on many factors including the degree of compaction. Important knowledge gaps include a lack of quantitative relationships between degree of SSD and soil hydraulic properties and processes (e.g., water movement and contaminant losses), and poor knowledge of critical thresholds or optimum ranges of soil physical indicators in relation to critical ecosystem services (e.g., pasture yield, gas and water regulation in soils). We also found few estimates of SSD-induced costs related to production and environmental outcomes (e.g., contaminant losses and N2O emissions) at either farm system, regional or national scales. More data are needed to better determine the true costs and implications for farm production and environmental effects associated with SSD.

Hu W, Drewry J, Beare M, Eger A, Müller K. 2021. Compaction induced soil structural degradation affects productivity and environmental outcomes: a review and New Zealand case study. Geoderma 395: 115035. https://doi.org/10.1016/j.geoderma.2021.115035

Impact of volumetric versus gravimetric assessment on Olsen P concentrations

Soil Olsen phosphorus is used for regional and national environmental reporting, and for farm soil fertility assessment. In New Zealand, the laboratory measurement using sieved and air-dried soil is undertaken gravimetrically (by weight), or volumetrically, so can be reported on either basis. Olsen P ‘stocks’ can also be calculated using field bulk density. These methods have led to inconsistencies in environmental reporting. This study compares and quantifies the relationships between the laboratory-determined gravimetric and volumetric Olsen P for a range of soil orders, by developing a statistical model. Our study showed there is a significant difference in Olsen P determined by volumetric and gravimetric methods, and the relationship varies with soil order. The gravimetric method gave elevated values for all soil orders compared with the volumetric method. Bulk density was generally significantly different from, and greater than, volume weight,

for many soil orders. From the statistical modelling, look-up tables are provided for converting from volumetric-to-gravimetric, and gravimetric-to-volumetric, in the absence of volume weight, such as for legacy data. Several recommendations to improve national environmental reporting are provided, including that, if the volumetric method is used, volume weight should be requested from the laboratory to enable consistent conversion for national reporting.

Drewry JJ, Stevenson BA, McNeill SJ, Cavanagh JE, Taylor MD. 2021. Impact of volumetric versus gravimetric assessment on Olsen P concentrations. New Zealand Journal of Agricultural Research. On line early. https://doi.org/10.1080/00288233.2021.1912118

The effect of irrigated land use intensification on the topsoil physical properties of a pastoral silt loam.

In Canterbury, New Zealand, there has been widespread conversion of dryland sheep grazing to more intensive irrigated dairying. We determined the effects of these land uses on soil physical properties, and water release characteristics, on adjacent sites: a centre-pivot sprinkler-irrigated dairy farm site, a dryland sheep site, and a non-grazed, non-irrigated control site. Despite the Pallic Soil being well drained, greater soil compaction occurred at the dairy site than at other sites, to at least 30 cm depth. The dairy site typically had significantly lower total porosity and macroporosity, and greater bulk density and volumetric water content, than the other sites. Available water capacity varied, but was greater at the dairy site (0–30 cm) than at the sheep site and control site. Further research is required across more farms and soils to confirm these results in other conditions.

Drewry JJ, Carrick S, Mesman NL, Almond P, Müller K, Shanhun FL, Chau H 2021. The effect of irrigated land use intensification on the topsoil physical properties of a pastoral silt loam. New Zealand Journal of Agricultural Research. On-line early. https://doi.org/10.1080/00288233.2021.1905670

Tephrochronology in Aotearoa New Zealand.

Tephra deposits in Aotearoa New Zealand (ANZ) have been studied for >180 years. The now-global discipline of tephrochronology, which has some developmental roots in ANZ, forms the basis of a powerful chronostratigraphic correlational tool and age-equivalent dating method for geological, volcanological, palaeoenvironmental, and archaeological research in ANZ. Its utility is founded on the key principle that tephras or cryptotephras provide widespread isochrons in many different environments. In the first part of this article, we summarise the history of tephra studies in ANZ and then describe how tephras have been mapped, characterised, and correlated using field and laboratory-based methods. We document advances in geochemical fingerprinting of glass; tephra/cryptotephra detection and correlation by sediment-core scanning methods (e.g. X-radiography, CT imaging, XRF elemental analysis, magnetic susceptibility); statistical correlation

methods; and dating of tephras/cryptotephras. We discuss the advent of ANZ cryptotephra studies (from mid-1970s) and their more-recent growth. The second part comprises examples of applications of tephrochronology in ANZ: climate-event stratigraphy (NZ-INTIMATE project); eruptive-event stratigraphy in the Auckland Volcanic Field; developments in the marine tephra record; advances in identifying, correlating, and dating old (pre-50 ka) tephras and weathered-tephra deposits; forming soils/paleosols on tephras; tephras and archaeology; Kopouatai bog tephrostratigraphy and palaeoenvironments; and volcanic-hazard assessments.

Hopkins, J.L., Lowe, D.J., Horrocks, J.L. 2021. Tephrochronology in Aotearoa New Zealand. *New Zealand Journal of Geology and Geophysics* 64 (2/3) [part of special issue on "Volcanism in Zealandia and SW Pacific"]
https://doi.org/10.1080/00288306.2021.1908368

Full inversion tillage during pasture renewal to increase soil carbon storage: New Zealand as a case study

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As soils under permanent pasture and grasslands have large topsoil carbon (C) stocks, the scope to sequester additional C may be limited. However, because C in pasture/grassland soils declines with depth, there may be potential to sequester additional C in the subsoil. Data from 247 continuous pasture sites in New Zealand (representing five major soil Orders and ~80% of the grassland area) showed that, on average, the 0.15–0.30 m layer contained 25–34 t ha^{-1} less C than the top 0.15 m. High-production grazed pastures require periodic renewal (re-seeding) every 7–14 years to maintain productivity. Our objective was to assess whether a one-time pasture renewal, involving full inversion tillage (FIT) to a depth of 0.30 m, has potential to increase C storage by burying C-rich topsoil and bringing low-C subsoil to the surface where C inputs from pasture production are greatest. Data from the 247 pasture sites were used to model changes in C stocks following FIT pasture renewal by predicting (1) the C accumulation in the new 0–0.15 m layer and (2) the decomposition of buried-C in the new 0.15–0.30 m layer. In the 20 years following FIT pasture renewal, soil C was predicted to increase by an average of 7.3–10.3 (Sedimentary soils) and 9.6–12.7 t C ha^{-1} (Allophanic soils), depending on the assumptions applied. Adoption of FIT for pasture renewal across all suitable soils (2.0–2.6 M ha) in New Zealand was predicted to sequester ~20–36 Mt C, sufficient to offset 9.6–17.5% of the country's cumulative greenhouse gas emissions from agriculture over 20 years at the current rate of emissions. Given that grasslands

account for ~70% of global agricultural land, FIT renewal of pastures or grassland could offer a significant opportunity to sequester soil C and offset greenhouse gas emissions.

E J Lawrence-Smith, D Curtin, M H Beare, S R McNally, F M Kelliher, R Calvelo Pereira, M J Hedley. 2021. Full inversion tillage during pasture renewal to increase soil carbon storage: New Zealand as a case study. Glob Chang Biol 27, 1998-2010. https://doi.org/10.1111/gcb.15561

Other recent papers

Lowe, D.J., Pittari, A. 2021. The Taupō eruption sequence of AD 232 ± 10 in Aotearoa New Zealand: a retrospection. *Journal of Geography (Chigaku Zasshi)* 130 (1)

Richter-de-Jorges, A. et al. 2021. Review of the world's soil museums and exhibitions. *Advancees in Agronomy* 266

Hartemink, A. et al. 2020. Soil horizon variation: a review. *Advances in Agron* 160, 125-185.

Ratcliffe, J.L. et al. 2020. Rapid carbon accumulation in a peatland following Late Holocene tephra deposition, NZ. *Quaternary Science Reviews* 246, 106505

Danišík, M., et al. 2020. Sub-millennial eruptive recurrence in the silicic Mangaone Subgroup tephra sequence, NZ, from Bayesian modelling... *Quaternary Sci Reviews* 246, 10651

Abbott, P.M. et al. (eds) 2020. "Tephrochronology as a global geoscientific research tool". *Journal of Quaternary Science* 35 (1/2), 1-379.

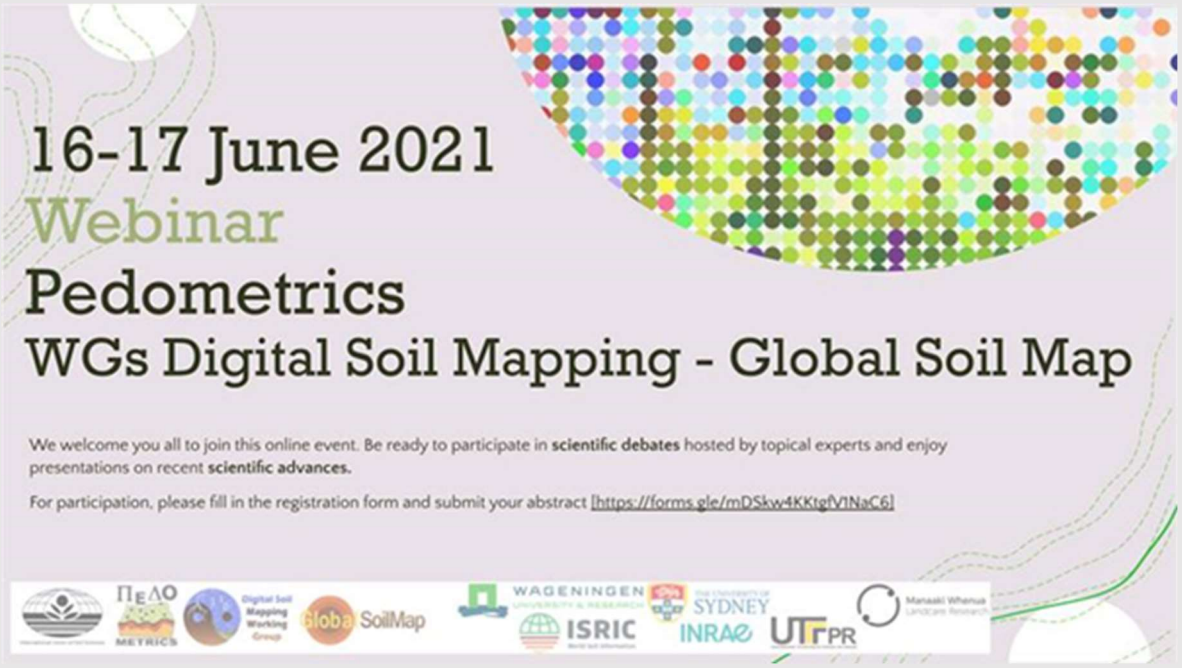
Conferences and Training

Upcoming conference - pedometrics webinar

The second Pedometrics webinar, this time focusing on topics relevant to the WGs Digital Soil Mapping (and Assessment) and Global Soil Map. The event will take place on 16 and 17 June 2021.

More details will soon be on the pedometrics website: http://pedometrics.org/

Abstract submission will close: June 4th **(no extension)**
Decision on abstract: June 9th
Program online: June 14th (latest)
Webinar: June 16-17 (online with Zoom)
Abstract submission and registration: https://forms.gle/mDSkw4KKtgfV1NaC6



Joint Australia/NZ Soil Science Conference

Nau mai, haere mai We look forward to welcoming everyone to the Waikato Hub of the joint Australia/NZ Soil Science Conference.

We can now confirm that the Waikato hub will definitely be going ahead at The University of Waikato so we can meet in person and easily link to the conference centre in Australia to maximise the ease of participating in our joint Australia-NZ Soil science conference. Check out the draft programme here see lots of not-to-be missed talks, and look forward to having a real catch up with colleagues over tea and lunch breaks. The NZ welcome function, for those attending in person, will be on the Monday evening after the first day of the conference.

Our conference dinner is an early evening trip on the Waikato River, after the fieldtrip, so will be an informal, fun, event. However, numbers are limited so you will need to get in quick to secure a place.

For people from out of town we recommend motels in either Hamilton East as they are in walking distance of Hamilton Gardens (the start and end point for the fieldtrip) and Hamilton East restaurants, with a half hour walk to the University. There is also one motel adjacent to the University. I am sure there are plenty of locals who will be happy to give anyone who needs it a ride to the venues – just ask us.

After the trials and tribulations of the last year and a half it is great to finally have this conference happening and we are really looking forward to meeting old friends and making new ones for those who can make it to Hamilton. But never fear, if you are planning on participating virtually, and for our friends across the ditch, we also look forward to seeing you on-line and hope we can connect one-on-one through chat facilities and the like.

Registrations are still open at the extended Earlybird rate: All fees are in NZD and include GST. If you have registered as a virtual attendee and now wish to attend in person, please email lea@on-cue.co.nz

FULL REGISTRATION:

MEMBER	NON-MEMBER	STUDENT MEMBER	STUDENT NON-MEMBER
$650	$750	$350	$400

DAY REGISTRATION:

MEMBER	NON-MEMBER	STUDENT MEMBER	STUDENT NON-MEMBER
$330	$380	$280	$320

REGISTER FOR THE NZSSS CONFERENCE HUB HERE

The field trip is being held on Wednesday 30th of June in the Wonderful Waikato. Depart Hamilton at 9.00 am. View the enigmatic but perfectly-formed Kainui soil (a Buried-granular Ultic Soil) and then learn about the latest work on GHG emissions on Organic Soils on peat in the area of Ohaupo/Cambridge before lunch at the special "Cafe Irresistiblue" adjacent to a blueberry orchard. After, visit Maanaki Whenua Landcare Research in Hamilton to view dung beetle experiments. Come back to the unique Te Parapara Garden at Hamilton Gardens for a cultural soil experience followed by dinner on the Waikato River Explorer boat, leaving from the Hamilton Gardens at 4.30pm

Cost: NZD$55 field trip only plus NZD$39 for dinner and boat ride
To book: Add this with your conference registration or contact lea@on-cue.co.nz

Deadline..... For the August 2021 issue of Soil News is Friday 13 August 2021

We are the New Zealand Soil News:
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